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Bryant-Rich

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(54) **MEMORY CARD AND HOST DEVICE**

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H01R 13/648 (2006.01)

(52) **U.S. Cl.** **439/607.22**; 439/76.1; 439/946

(58) **Field of Classification Search** 439/946,
439/76.1, 607.22, 465, 731, 687; 361/679.31;
29/747

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

- 6,045,384 A 4/2000 Norizuki et al.
- 6,213,804 B1 4/2001 Matsumura
- 6,217,351 B1 4/2001 Fung et al.
- 6,567,273 B1 5/2003 Liu et al.
- 6,622,195 B2 9/2003 Osakada et al.
- 6,676,420 B1 1/2004 Liu et al.
- 6,799,719 B2 10/2004 Peng
- 6,908,038 B1 6/2005 Le
- 7,052,287 B1* 5/2006 Ni et al. 439/76.1

- 7,074,052 B1 7/2006 Ni et al.
- 7,104,809 B1 9/2006 Huang
- 7,114,030 B2 9/2006 Teicher et al.
- 7,151,673 B2 12/2006 Le et al.
- 7,152,801 B2 12/2006 Cuellar et al.
- 7,259,967 B2* 8/2007 Ni 361/760
- 7,274,491 B2 9/2007 Yamada et al.
- 7,310,692 B2 12/2007 Miller et al.
- 7,364,436 B2 4/2008 Yen
- 7,406,572 B1 7/2008 Nguyen
- 7,466,556 B2 12/2008 Hiew et al.
- 7,479,042 B2 1/2009 Chen
- 7,481,659 B2 1/2009 Johnson et al.
- 7,491,076 B2 2/2009 Gu et al.

(Continued)

FOREIGN PATENT DOCUMENTS

WO 2008146285 A2 12/2008

OTHER PUBLICATIONS

Notice of Allowance and Fees Due mailed Mar. 15, 2012 in U.S. Appl. No. 12/393,267, 10 pages.

(Continued)

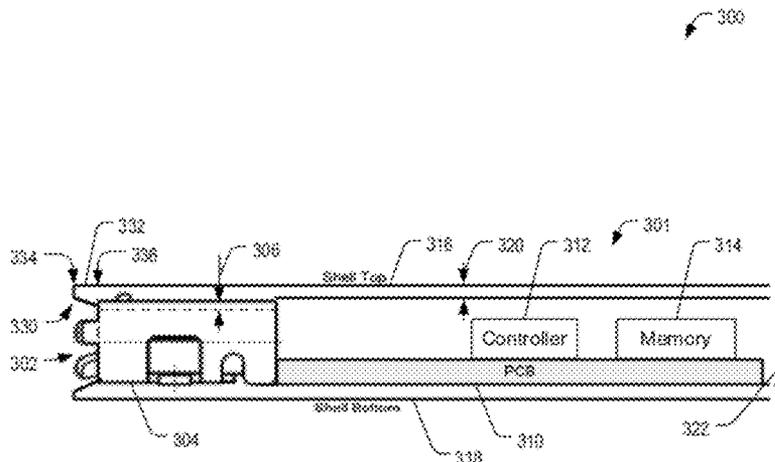
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(57) **ABSTRACT**

A memory card structure includes a memory card body dimensioned to house a memory and a controller, and the memory card body has an edge connector portion having a thickness that complies with a memory card specification. The memory card body includes a recessed portion dimensioned to receive an external plug. The memory card structure also includes an electrical connector that is coupleable to a Universal Serial Bus (USB) plug and that is electrically coupled to at least one of the memory and the controller. The electrical connector extends from the recessed portion of the memory card body.

20 Claims, 17 Drawing Sheets



U.S. PATENT DOCUMENTS

7,535,718	B2 *	5/2009	Le	361/737
7,597,268	B2	10/2009	Jones et al.	
7,719,847	B2	5/2010	Mambakkam et al.	
8,109,772	B2 *	2/2012	Lin	439/76.1
8,206,161	B1 *	6/2012	Lan et al.	439/76.1
8,215,991	B2 *	7/2012	Bryant-Rich	439/607.22
2002/0166009	A1	11/2002	Lin	
2003/0100203	A1	5/2003	Yen	
2003/0191882	A1	10/2003	Chang	
2004/0033727	A1	2/2004	Kao	
2004/0054863	A1	3/2004	Harada et al.	
2004/0088449	A1	5/2004	Sakaki	
2004/0148450	A1	7/2004	Chen et al.	
2004/0153597	A1	8/2004	Kanai et al.	
2004/0174683	A1	9/2004	McGowan	
2005/0059273	A1	3/2005	Chiou et al.	
2005/0070138	A1	3/2005	Chiou et al.	
2005/0085133	A1	4/2005	Wang et al.	
2005/0086413	A1	4/2005	Lee et al.	
2005/0122648	A1 *	6/2005	Wu et al.	361/62
2005/0160223	A1	7/2005	Chen et al.	
2005/0197017	A1	9/2005	Chou et al.	
2006/0278723	A1	12/2006	Dan et al.	
2007/0168668	A1	7/2007	Chang et al.	
2007/0178769	A1	8/2007	Ni	
2007/0184719	A1	8/2007	Ni et al.	
2007/0197101	A1	8/2007	Ni et al.	
2008/0032561	A1	2/2008	Hiew et al.	
2008/0062624	A1	3/2008	Regen et al.	
2008/0067248	A1	3/2008	Hiew et al.	
2008/0096429	A1	4/2008	Mikolajczak et al.	
2008/0140887	A1	6/2008	Gallant et al.	
2008/0227337	A1	9/2008	Jow	
2009/0002548	A1	1/2009	Liang et al.	
2009/0098773	A1 *	4/2009	Cheng et al.	439/607.22

2009/0255991	A1	10/2009	Liao et al.
2009/0289119	A1	11/2009	Liao et al.
2009/0321530	A1	12/2009	Harari et al.
2010/0023669	A1	1/2010	Lee
2010/0217910	A1	8/2010	Bryant-Rich

OTHER PUBLICATIONS

Non-Final Office Action mailed Aug. 24, 2011 in U.S. Appl. No. 12/393,267, 9 pages.
 Advisory Action mailed Jul. 25, 2011 in U.S. Appl. No. 12/393,267, 3 pages.
 Final Office Action mailed Mar. 31, 2011 in U.S. Appl. No. 12/393,267, 8 pages.
 Non-Final Office Action mailed Aug. 26, 2010 in U.S. Appl. No. 12/393,267, 16 pages.
 Notice of Allowance and Fees Due mailed Mar. 8, 2012 in U.S. Appl. No. 12/393,457, 5 pages.
 Notice of Allowance and Fees Due mailed Dec. 13, 2011 in U.S. Appl. No. 12/393,457, 5 pages.
 Notice of Allowance and Fees Due mailed Sep. 7, 2011 in U.S. Appl. No. 12/393,457, 9 pages.
 Non-Final Office Action mailed Apr. 4, 2011 in U.S. Appl. No. 12/393,457, 9 pages.
 "CF+ and CompactFlash Specification", Feb. 16, 2007, revision 4.1, CompactFlash Association, 194 pages.
 "PC Card Standard, Physical Specification", 2001, vol. 3, PCMCIA/ JEITA, 80 pages.
 "Universal Serial Bus 3.0 Specification", Nov. 12, 2008, revision 1.0, 482 pages.
 "IEEE Standard for a High-Performance Serial Bus," IEEE Std 1394™—2008, Oct. 21, 2008, 954 pages.

* cited by examiner

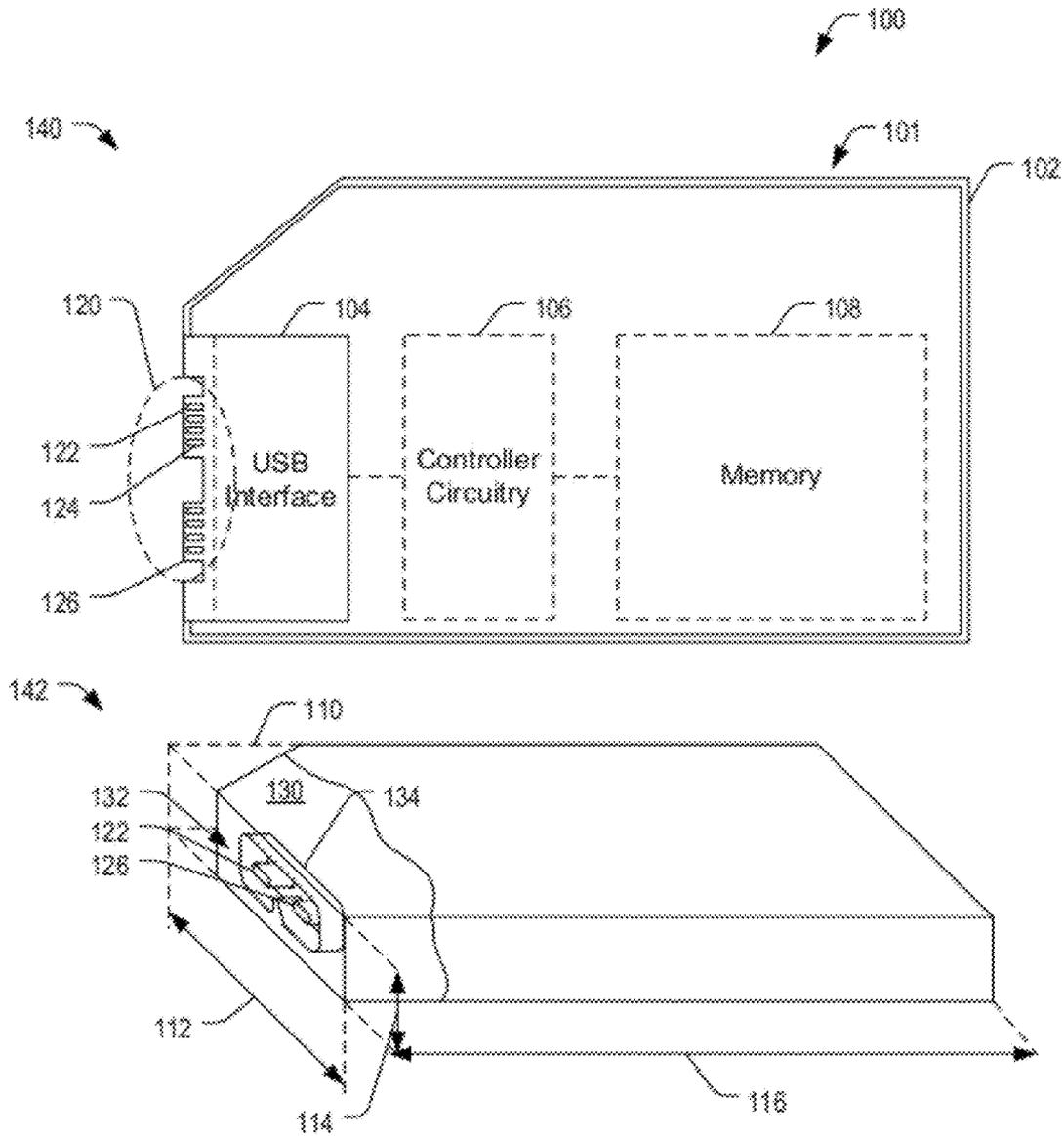


FIG. 1

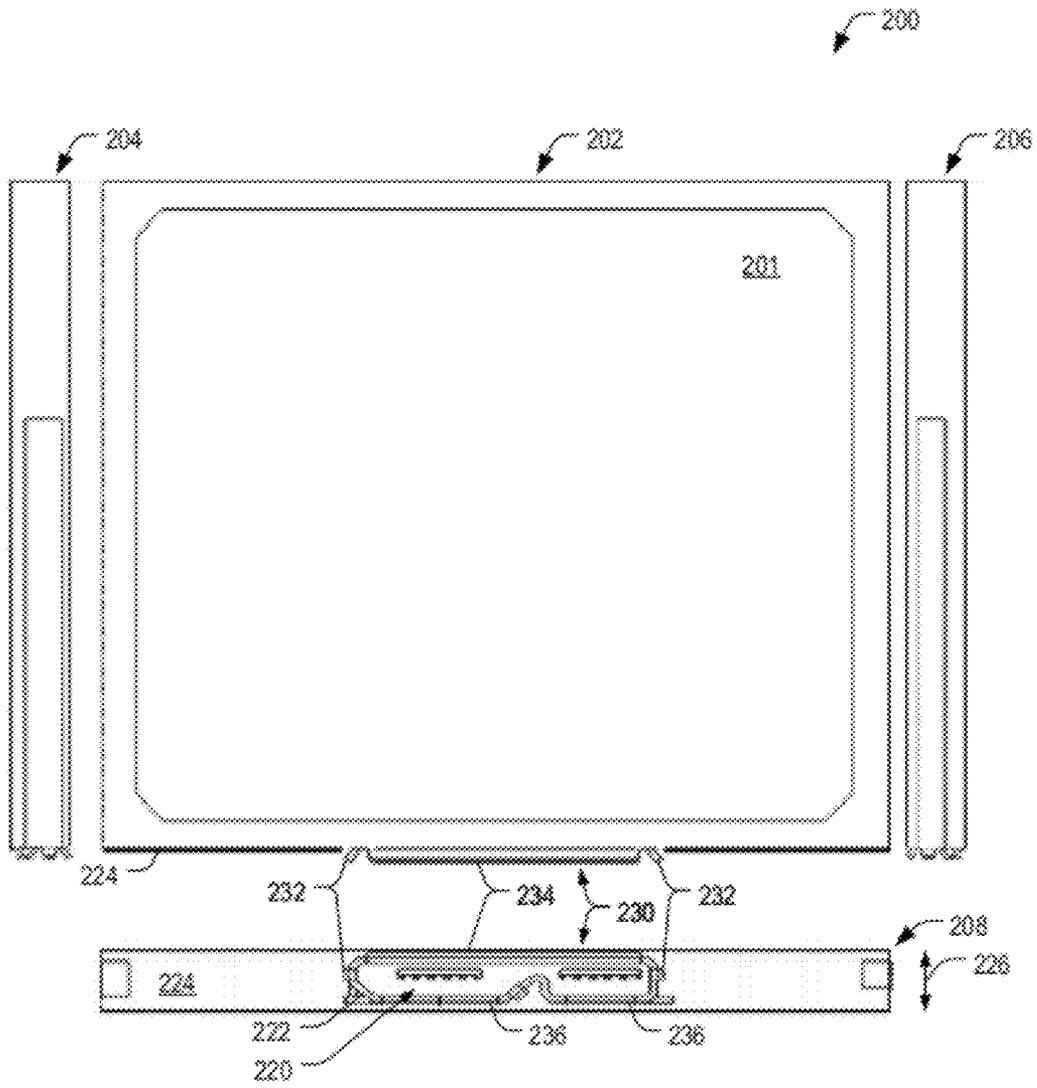


FIG. 2

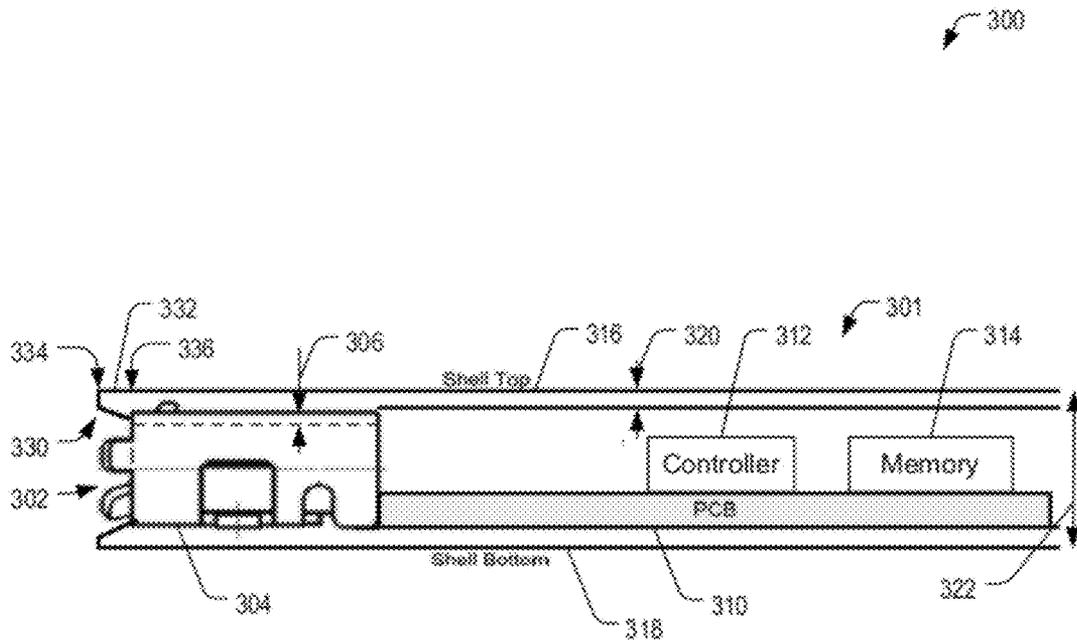


FIG. 3

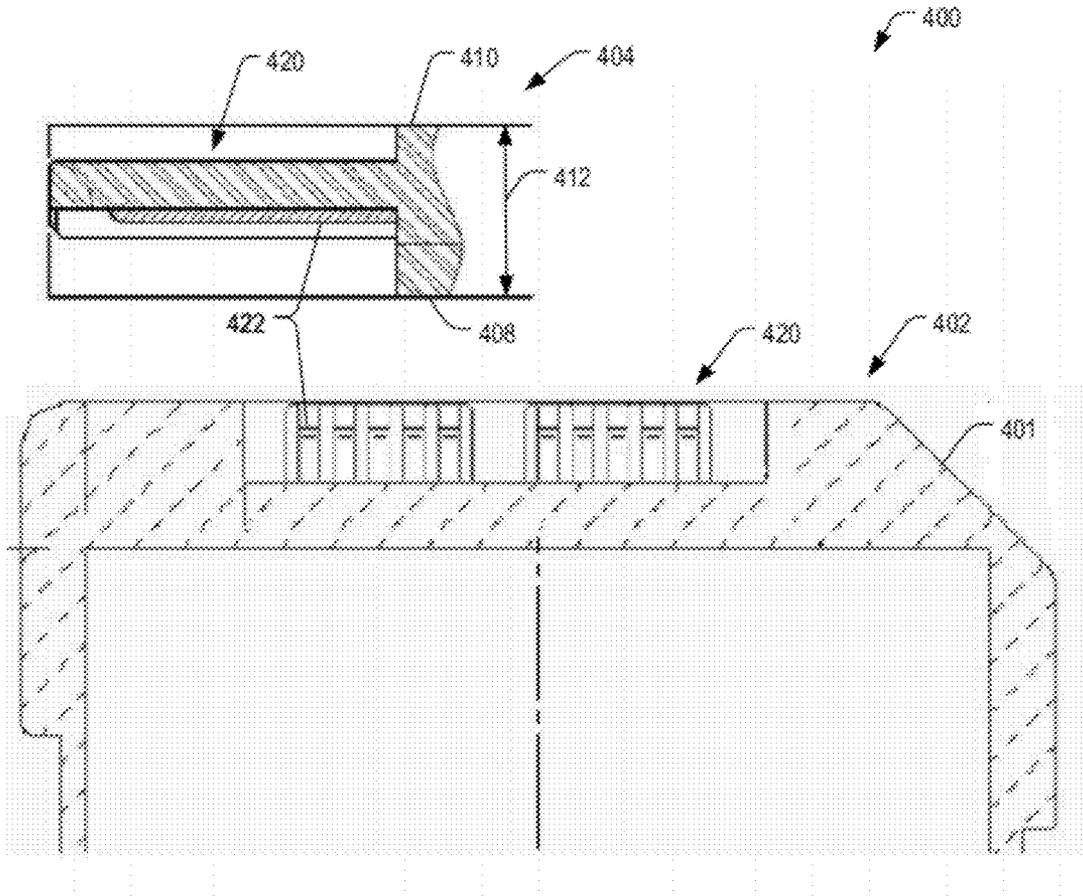


FIG. 4

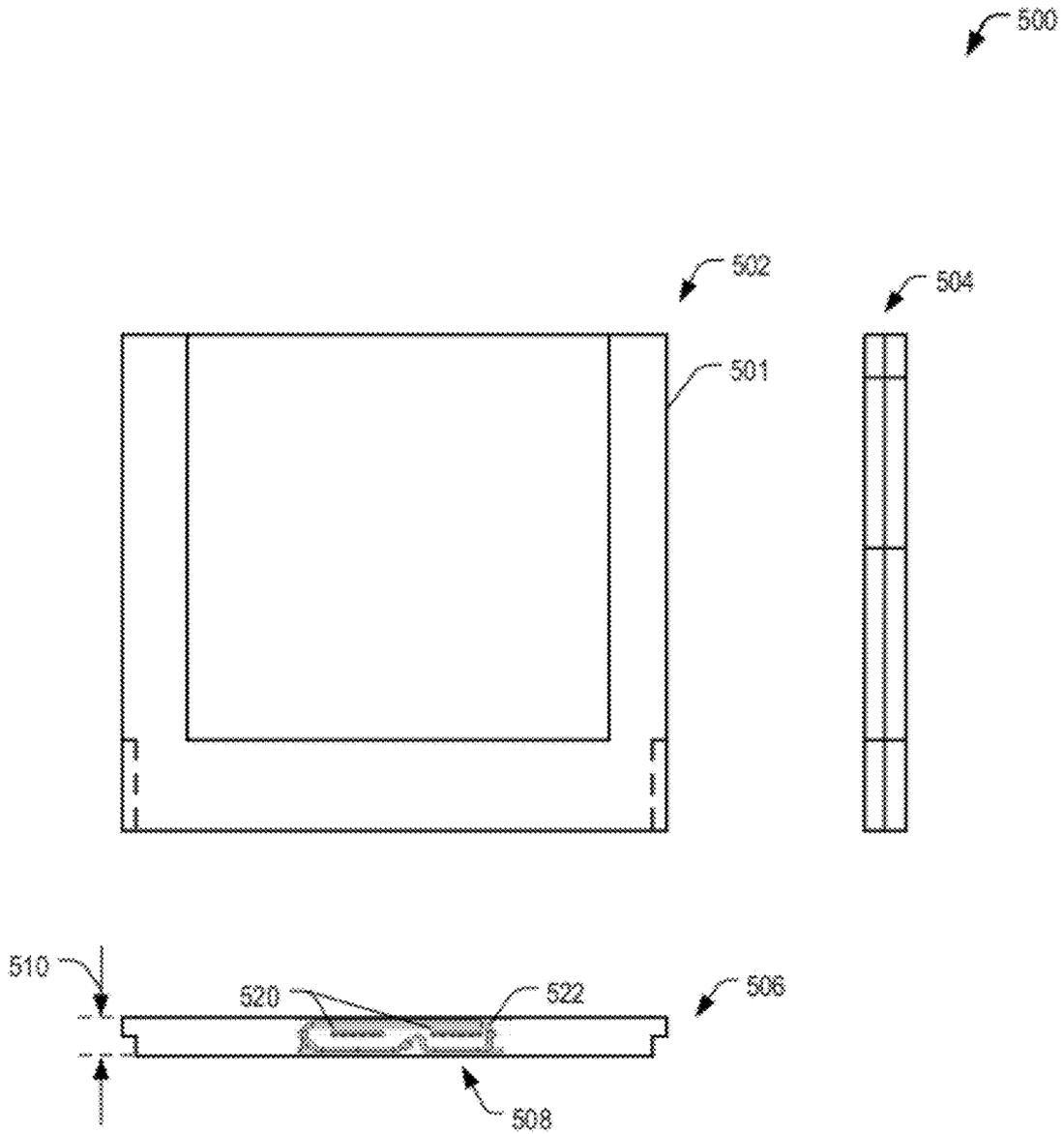


FIG. 5

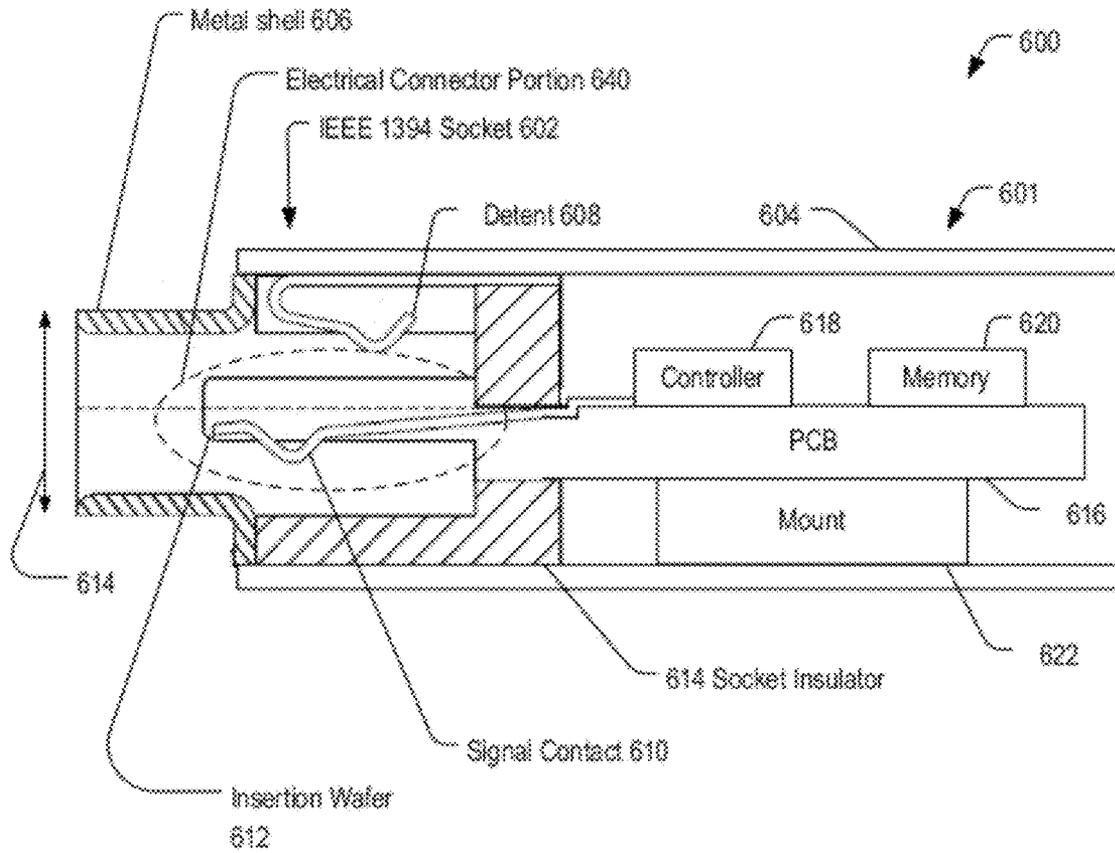


FIG. 6

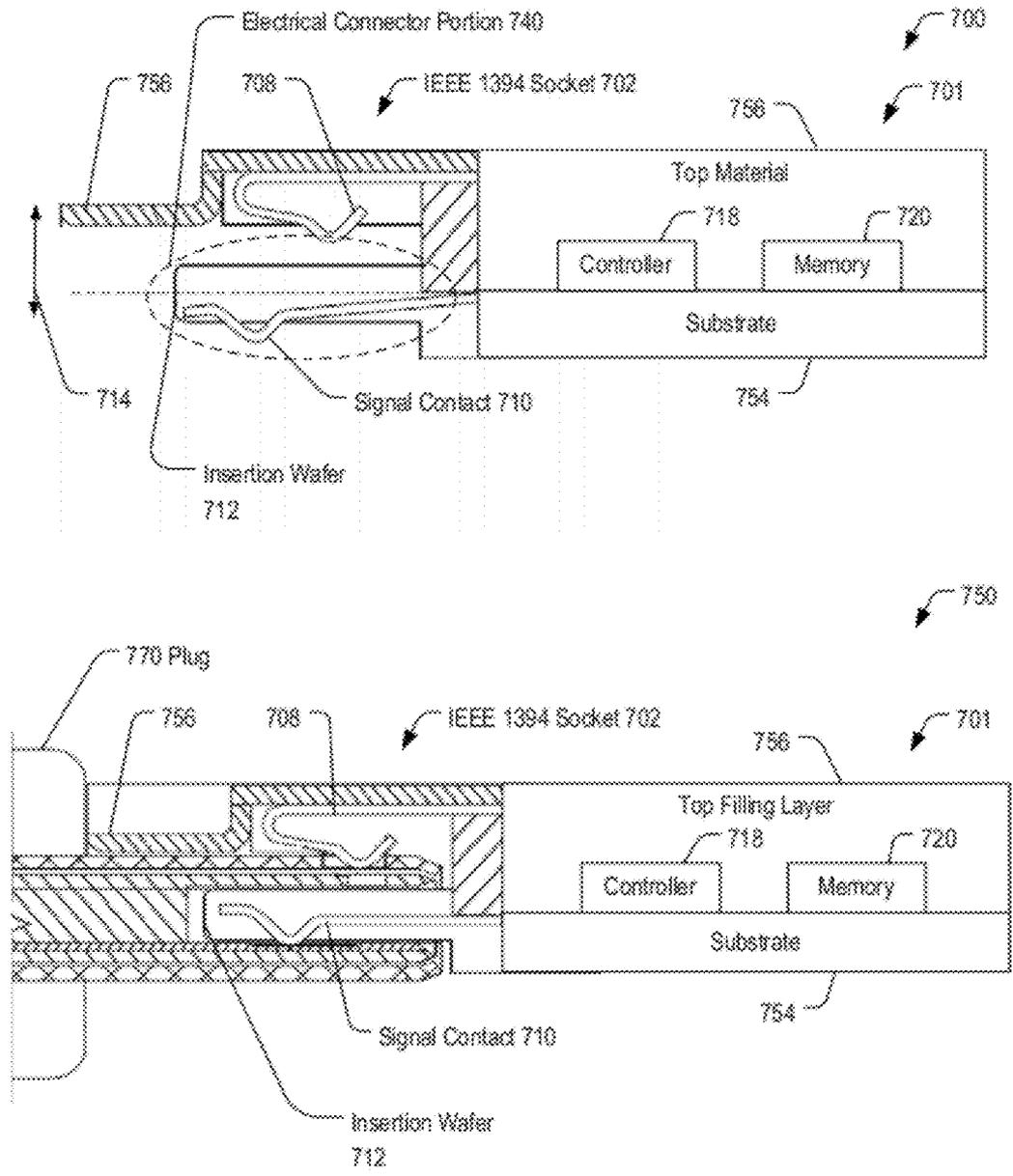


FIG. 7

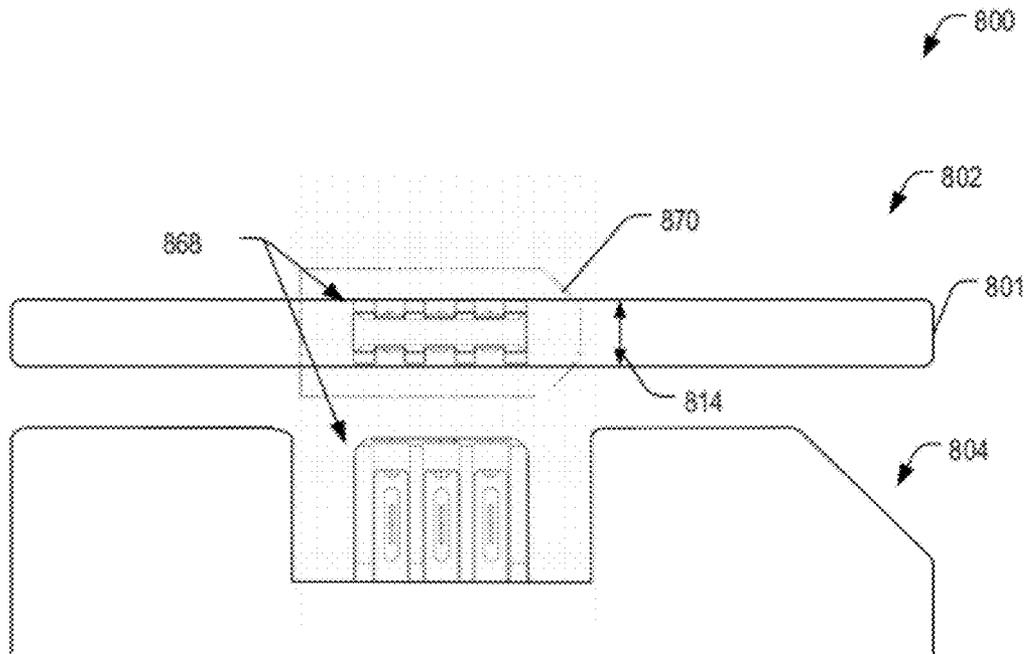


FIG. 8

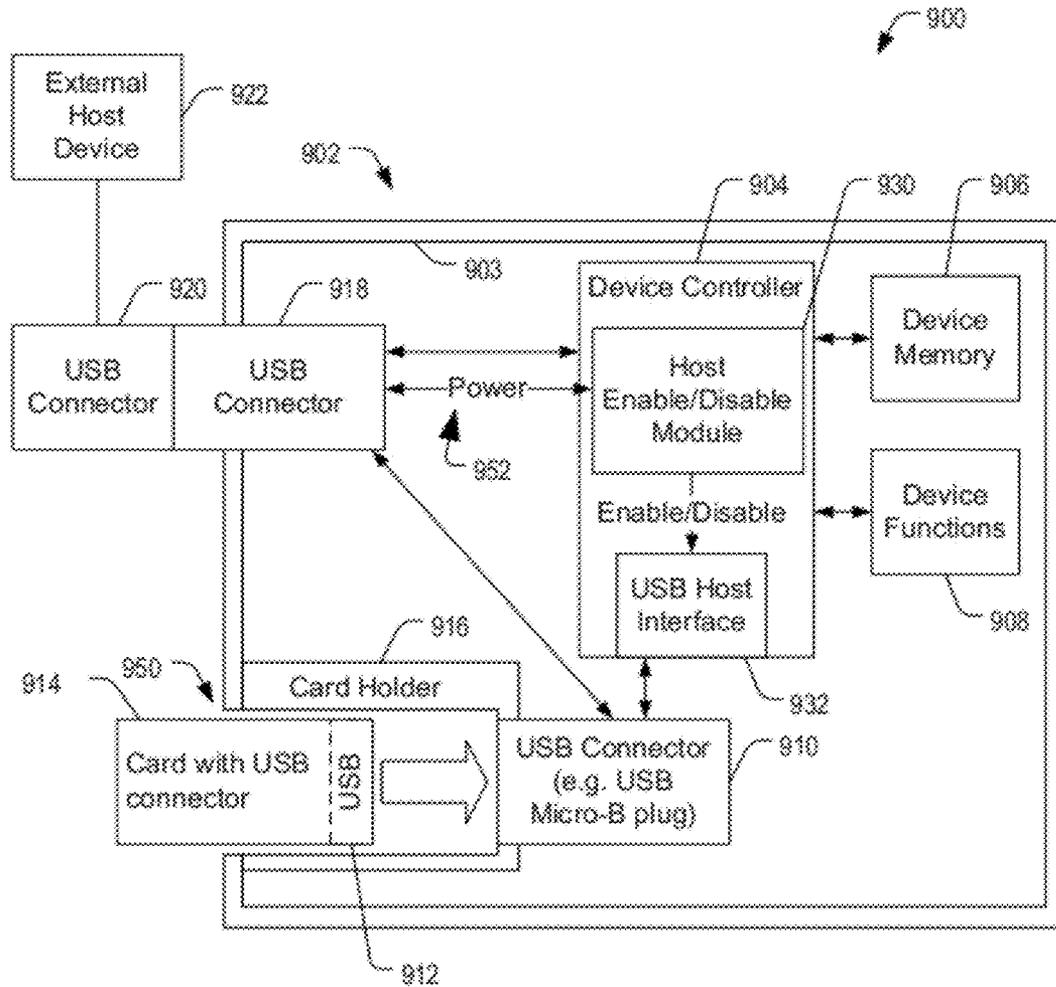


FIG. 9

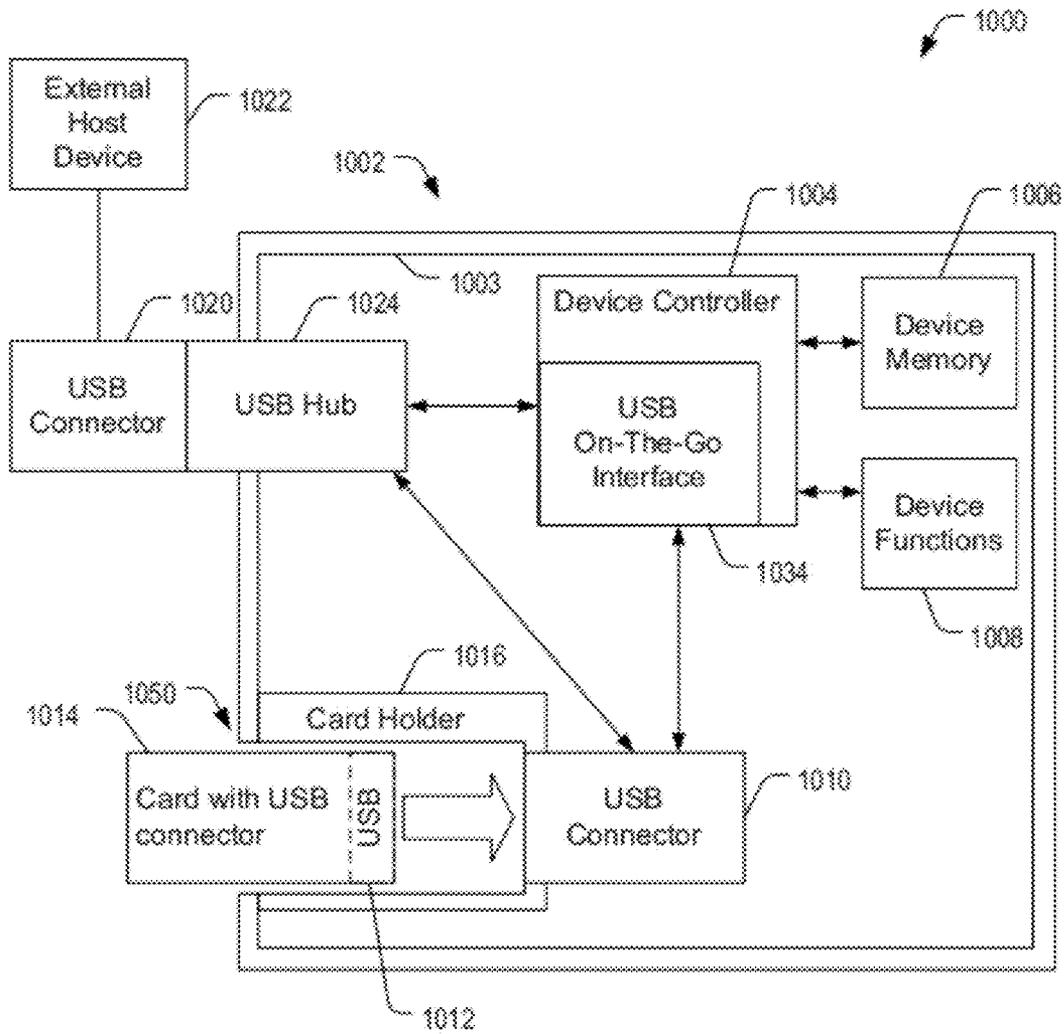


FIG. 10

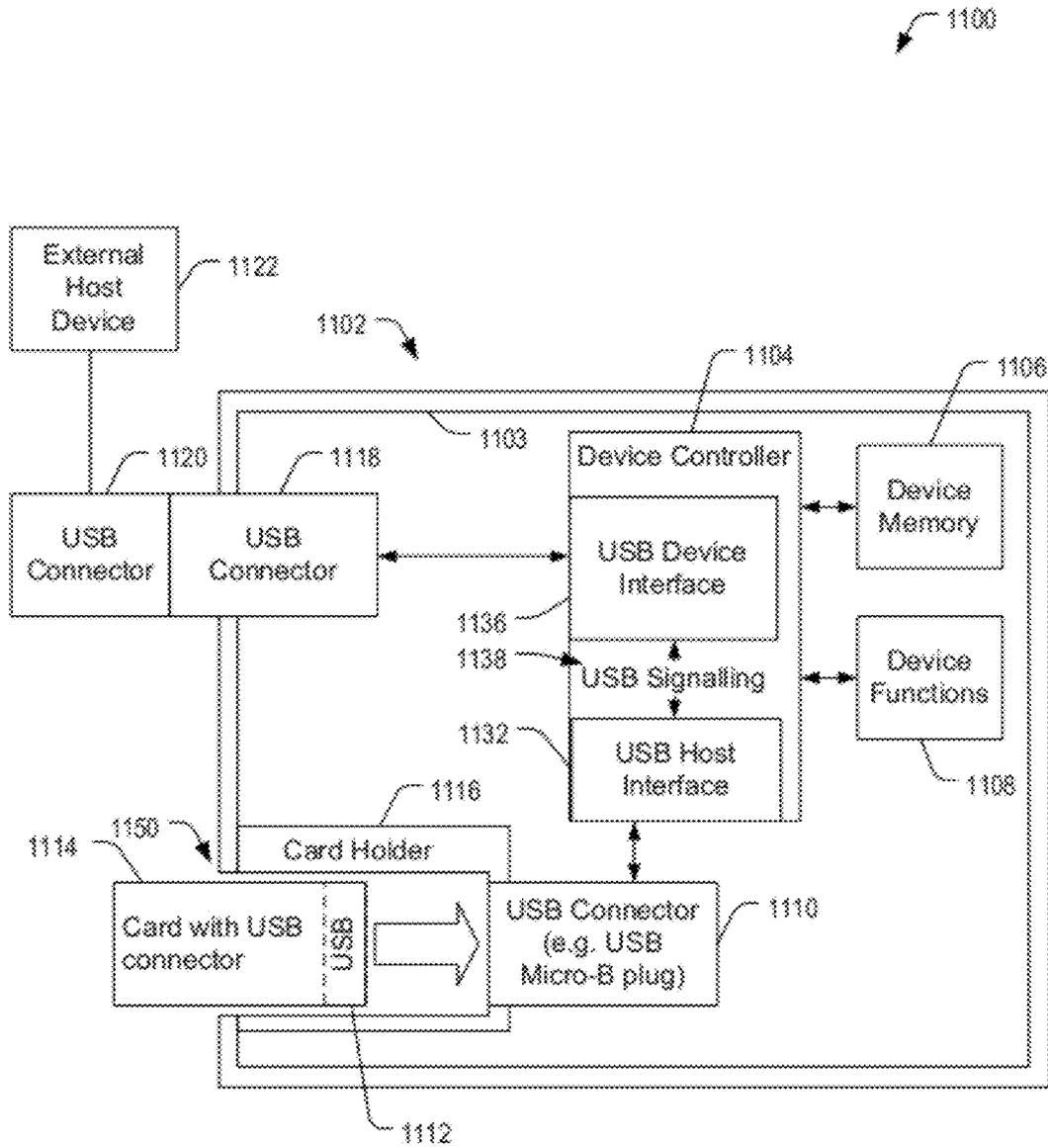


FIG. 11

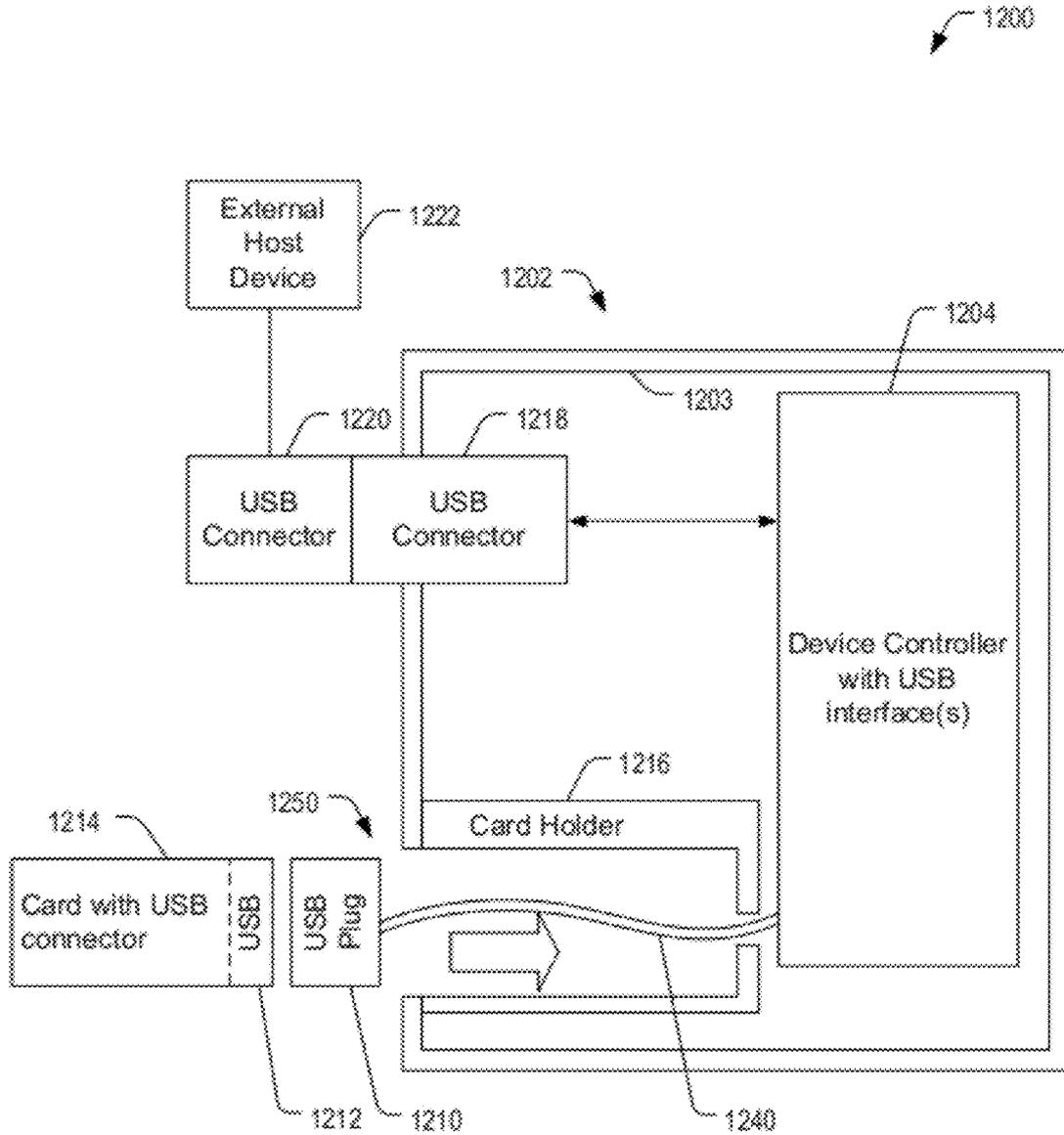


FIG. 12

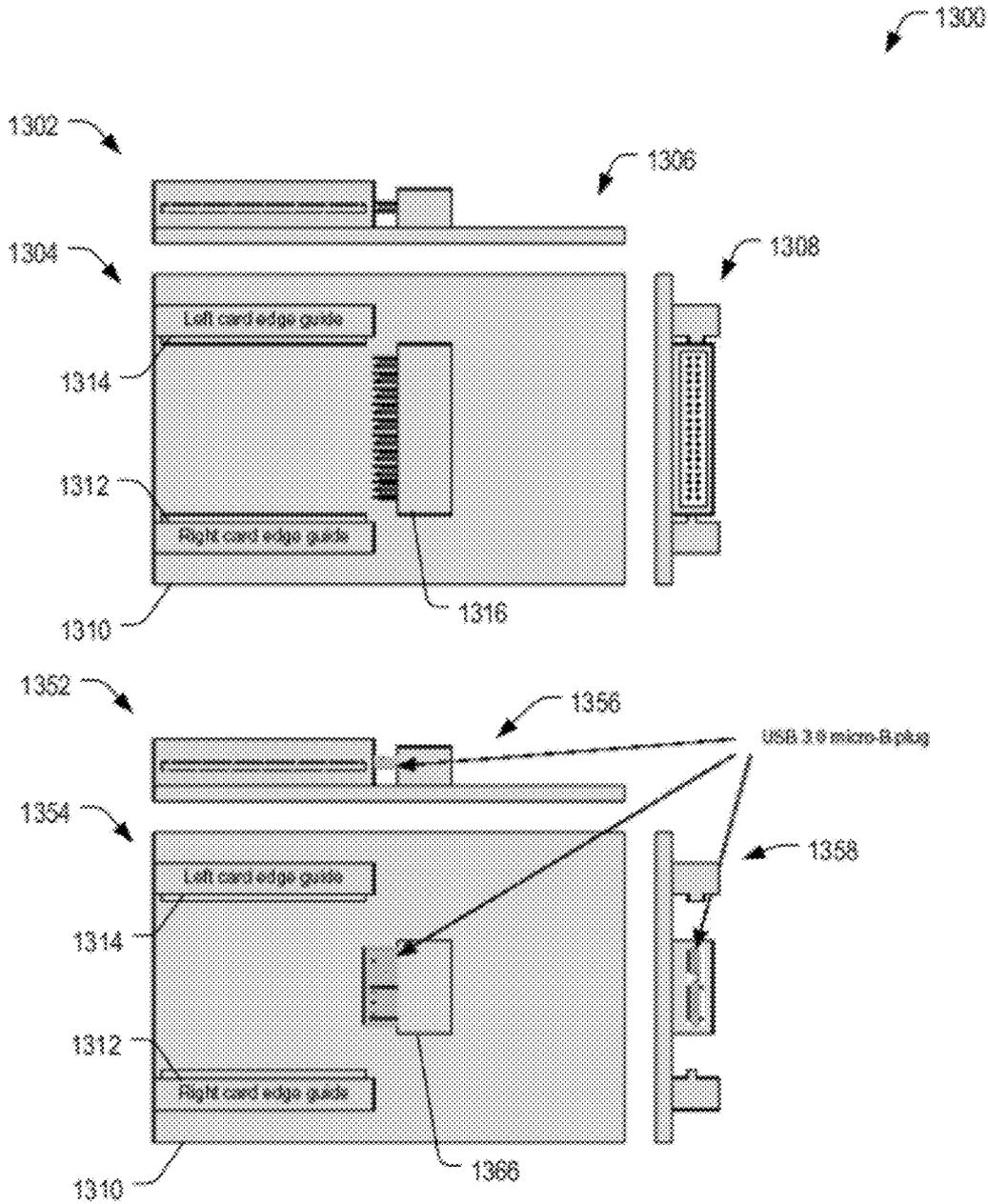


FIG. 13

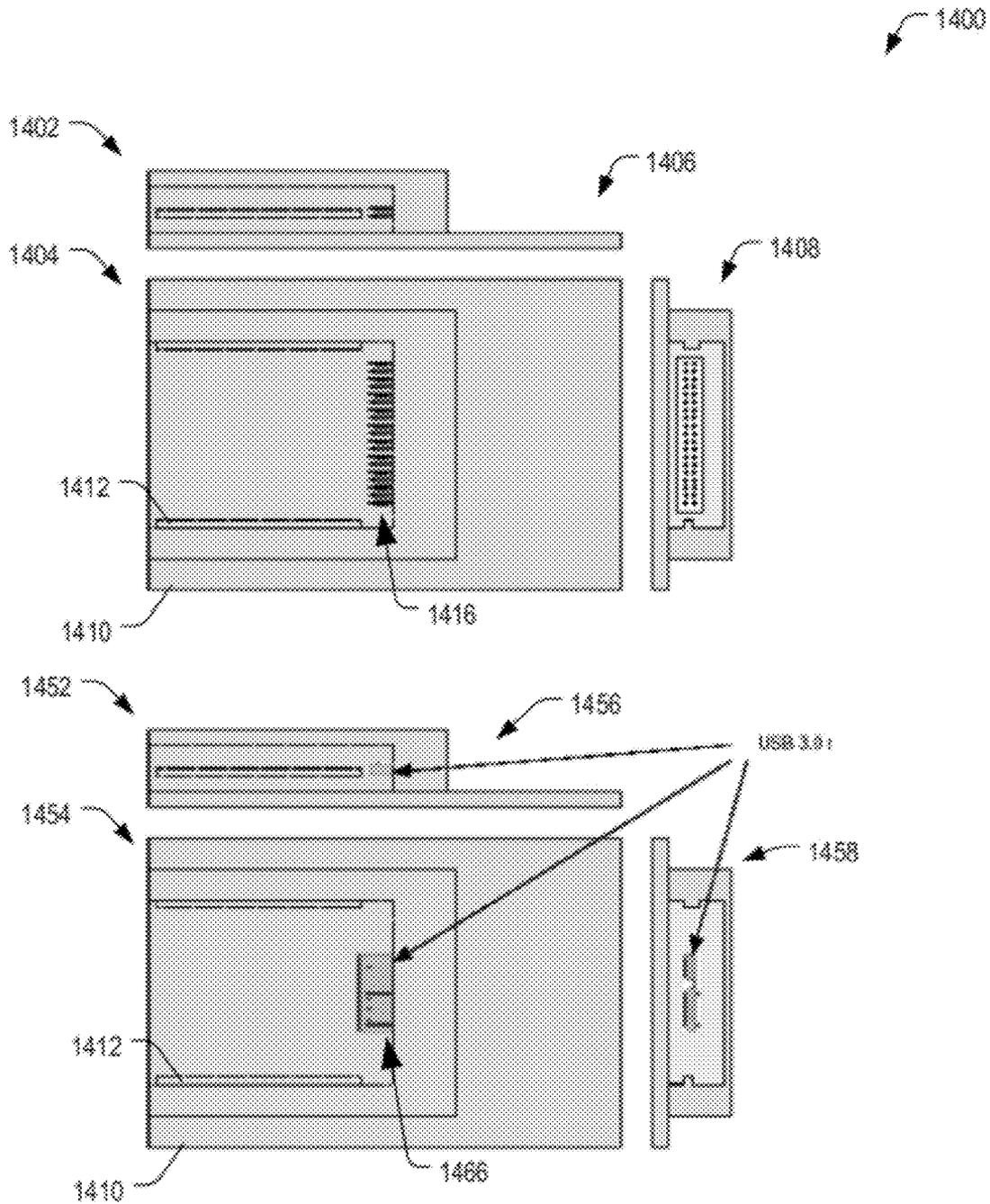


FIG. 14

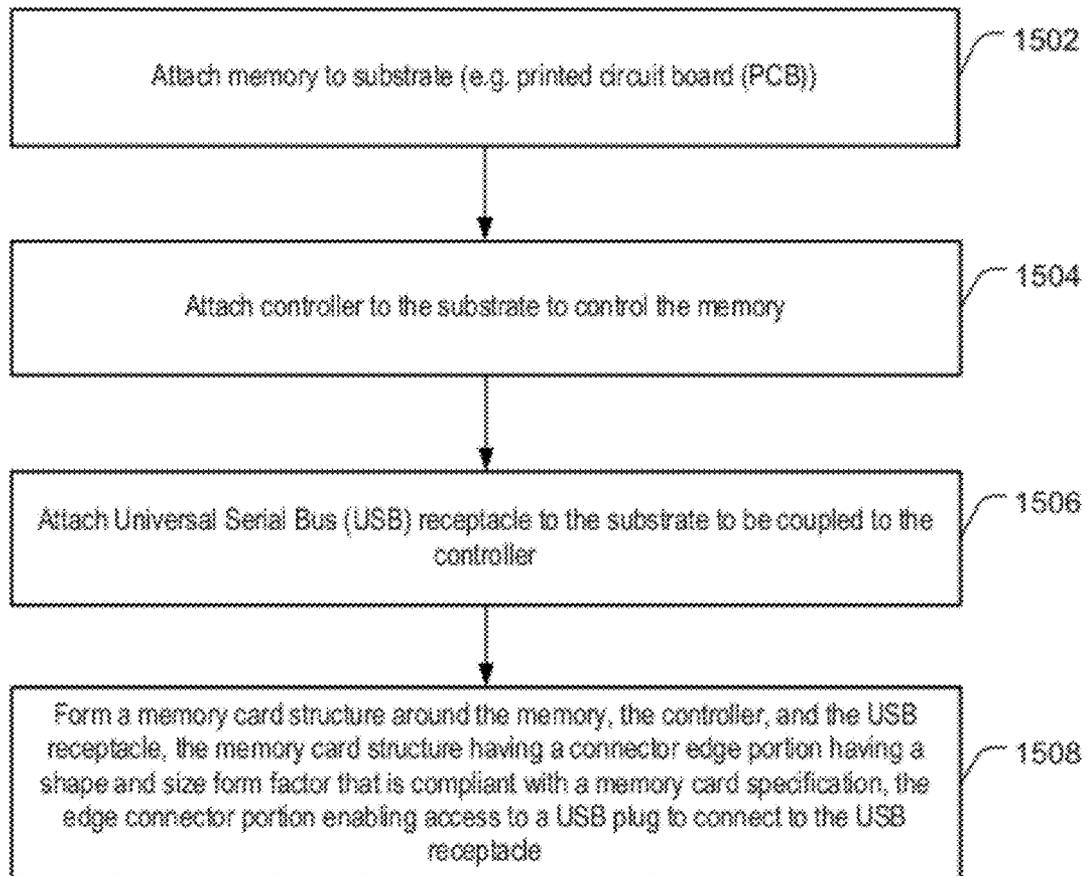


FIG. 15

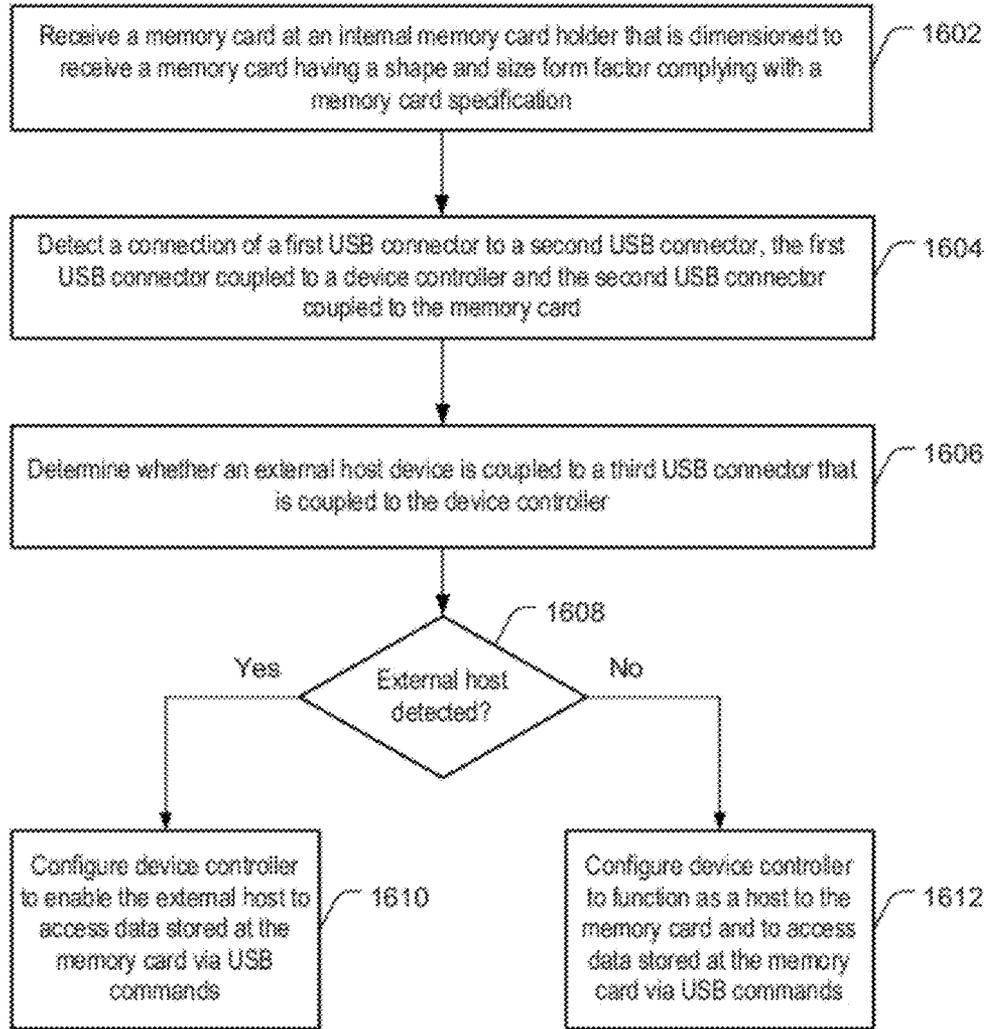


FIG. 16

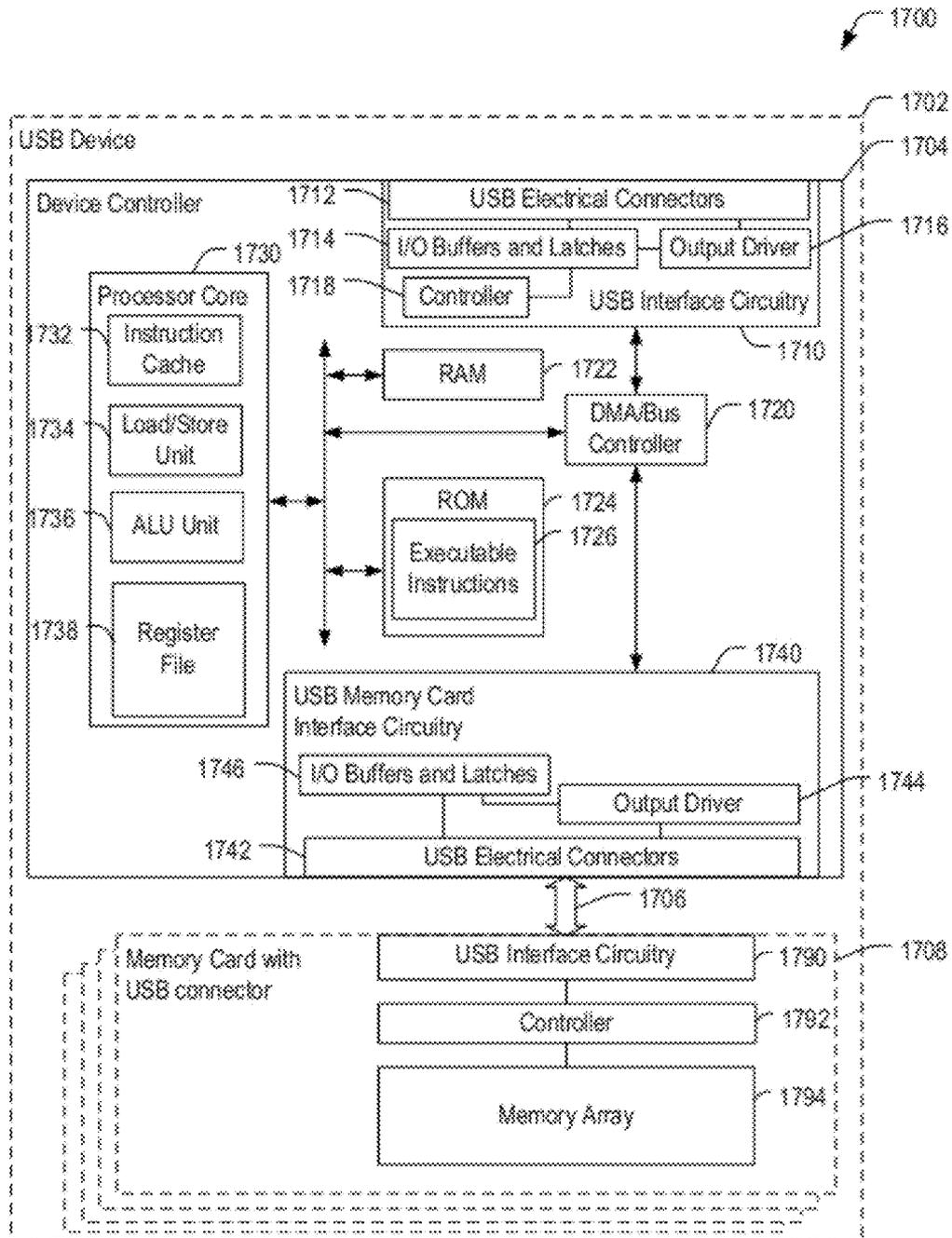


FIG. 17

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MEMORY CARD AND HOST DEVICE

CROSS-REFERENCE TO RELATED
APPLICATIONS

The present application is a continuation of and claims priority from U.S. application Ser. No. 12/393,457, filed Feb. 26, 2009, which application is hereby incorporated by reference in its entirety.

FIELD OF THE DISCLOSURE

The present disclosure is generally related to memory cards and host devices.

BACKGROUND

Non-volatile semiconductor memory devices, such as removable memory cards, have enabled increased portability of data and software applications. Various devices, such as cameras, phones, personal digital assistants, and printers, have internal card holders to receive removable memory cards for data storage. Often, such devices can also be coupled to an external host, such as a personal computer, for data transfer between the device and the external host. Conventionally, data and instructions may be transferred between the device and the external host according to a Universal Serial Bus (USB) specification or an Institute of Electrical and Electronic Engineers (IEEE) 1394 interface standard, also known as the Firewire standard.

Data and instructions are conventionally transferred between the device and the removable memory card via a standard other than a USB or an IEEE 1394 interface standard. For example, communication between the device and the memory card can comply with a Personal Computer Memory Card International Association (PCMCIA) standard, such as a PC Card standard, or a flash memory card standard, such as a CompactFlash (CF), Secure Digital (SD) or Multimedia Card (MMC) standard. As a result, the device typically implements multiple protocols and provides translations between the protocols to enable communication between the external host and the removable memory card. Implementing multiple protocols and providing translations between the protocols may increase the cost and complexity of such devices and may consume additional processing resources and physical space on the non-volatile memory device.

SUMMARY

Memory cards are disclosed having an edge connector portion that satisfies a shape and size form factor, such as a thickness, of a flash memory card or PCMCIA specification and that also implement a USB interface via a USB connector or an IEEE 1394 interface standard via an IEEE 1394 interface standard connector. An electrical connector portion of a USB or IEEE 1394 compatible receptacle may be attached within the edge connector portion of the memory card structure to remain stationary with respect to the memory card structure. Communication may be enabled between the memory card and an external host via the device that houses the memory card without protocol translation by the device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a general diagram of a first illustrative embodiment of a memory card having a USB interface, the memory

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card including a memory card structure and an electrical connector portion of a USB compatible receptacle that is attached to remain stationary within an edge connector portion of the memory card structure;

5 FIG. 2 is a general diagram of a second illustrative embodiment of a memory card having a USB interface;

FIG. 3 is a general diagram of a third illustrative embodiment of a memory card having a USB interface;

10 FIG. 4 is a general diagram of a fourth illustrative embodiment of a memory card having a USB interface;

FIG. 5 is a general diagram of a fifth illustrative embodiment of a memory card having a USB interface;

FIG. 6 is a general diagram of a first illustrative embodiment of a memory card having an IEEE 1394 interface;

15 FIG. 7 is a general diagram of a second illustrative embodiment of a memory card having an IEEE 1394 interface;

FIG. 8 is a general diagram of a third illustrative embodiment of a memory card having an IEEE 1394 interface;

20 FIG. 9 is a block diagram of a first illustrative embodiment of a system including a card holder to receive a memory card having a USB interface;

FIG. 10 is a block diagram of a second illustrative embodiment of a system including a card holder to receive a memory card having a USB interface;

25 FIG. 11 is a block diagram of a third illustrative embodiment of a system including a card holder to receive a memory card having a USB interface;

FIG. 12 is a block diagram of a fourth illustrative embodiment of a system including a card holder to receive a memory card having a USB interface;

30 FIG. 13 is a general diagram of a first illustrative embodiment of a memory card holder dimensioned to hold a memory card having a USB or IEEE 1394 interface;

35 FIG. 14 is a general diagram of a second illustrative embodiment of a memory card holder dimensioned to hold a memory card having a USB or IEEE 1394 interface;

FIG. 15 is a flow diagram of a particular embodiment of a method of making a memory card having a USB interface;

40 FIG. 16 is a flow diagram of a particular embodiment of a method of selecting a host to communicate with a memory card having a USB interface; and

FIG. 17 is a block diagram of an illustrative system that can be used to enable access to a memory card via a USB interface.

DETAILED DESCRIPTION

Referring to FIG. 1, a first illustrative embodiment 100 of a storage device, such as a memory card 101, is shown having a USB interface 104 and an electrical connector portion 120 of a USB compatible receptacle 132. In this embodiment, the USB compatible receptacle 132 is attached within an edge connector portion 130 of a memory card structure 102 to remain stationary with respect to the memory card structure 102. The memory card 101 is depicted in a top cross-sectional view 140 and a partial cutaway perspective view 142. The memory card 101 includes a memory card structure 102 that encloses a USB interface 104 and that may at least partially enclose a memory 108 and controller circuitry 106 coupled to the USB interface 104. By incorporating the USB interface 104 within the memory card 101, data may be accessed at the memory 108 using USB protocol commands and standard USB interconnection equipment, such as USB cables. The memory card 101 may be used with existing hardware that is configured to hold conventional memory cards according to various memory card specifications, such as PCMCIA or flash memory card specifications such as CompactFlash

(CF), Secure Digital (SD), microSD, other memory card specifications, or any combination thereof.

As illustrated, the USB interface **104** includes the electrical connector portion **120** of the USB compatible receptacle **132**. The electrical connector portion **120** may include a first set of contacts **122** and a second set of contacts **126** in accordance with USB 3.0 or a single set of contacts **126** in accordance with USB 2.0. The first set of contacts **122** and the second set of contacts **126** may each include multiple electrically conductive portions, such as a representative contact **124**. The electrical connector portion **120** of the USB compatible receptacle **132** may be configured to substantially match a USB specification shape and size form factor for the connector. For example, the electrical connector portion **120** and a metal shield **134** that at least partially surrounds the electrical connector portion **120** may substantially comply with the electrical connector portion of a USB micro-B specification.

The memory card structure **102** and the USB compatible receptacle **132** have outer dimensions not exceeding a bounding box **110** formed of a width dimension **112**, a length dimension **116**, and a thickness dimension **114** of an edge connector portion **130**. These dimensions are compatible with a flash memory card specification, such as a CompactFlash specification, a Secure Digital (SD) specification, a miniSD specification, a microSD specification or a Multimedia Card (MMC) specification, or a PCMCIA specification. As illustrated, the thickness dimension **114** is smaller than the width dimension **112** and is also smaller than the length dimension **116**.

The electrical connector portion **120** is attached within the edge connector portion **130** to remain stationary with respect to the memory card structure **102**. The electrical connector portion **120** may be immovable with respect to the memory card structure **102**. For example, the electrical connector portion **120** may be mounted or attached to the edge connector portion **130** of the memory card structure **102** or to a substrate (not shown), such as a printed circuit board, that is attached to the memory card structure **102**. The electrical connector portion **120** may be attached via adhesive, mechanical fasteners, or other fastening techniques. For example, the electrical connector portion **120** may be integrated into the memory structure **102** via a molding process that forms the memory structure **102**. As a result of the electrical connector portion **120** being mounted and remaining immobile with respect to the memory card structure **102** during operation, the memory card **101** may be more durable and less expensive to produce as compared to a storage device having a sliding or other user-movable connection component.

In a particular embodiment, the memory card structure **102** of the memory card **101** may substantially conform to physical dimensional specifications of one or more particular memory card types. For example, the memory card structure **102** may substantially conform to a shape and size form factor of a memory card specification. In another embodiment, however, only the edge connector portion **130** of the memory card structure **102** complies with a shape and size form factor of the memory card specification. For example, the edge connector portion **130** may be dimensioned to be inserted into existing memory card holders that have been modified to include USB connectors.

Referring to FIG. 2, a particular embodiment of a memory card **201** having a USB interface is depicted and generally designated **200**. The memory card **201** is depicted in a top view **202**, a left edge view **204**, a right edge view **206**, and a front edge view **208**. The memory card **201** includes a USB compliant connector, such as a USB connector **230**, that is partially or fully recessed within an edge connector portion

224 of the memory card **201**. As illustrated, the USB connector **230** is a USB receptacle, such as a USB 3.0 micro-B receptacle, that is at least partially disposed within the memory card structure and that is attached within the edge connector portion **224** to remain stationary with respect to the memory card **201**.

The USB connector **230** has left and right insertion guides **232**. In addition, the USB connector **230** may also include a top insertion guide **234** and a bottom insertion guide **236**. The insertion guides **232-236** may assist connection of a USB plug into the USB connector **230**. At least one insertion guide **232-236** protrudes beyond or outside of an edge of the edge connector portion **224**. In the illustrated embodiment, the entire USB connector **230** other than the insertion guides **232-236**, such as an entire electrical connector portion **220**, is recessed within the edge connector portion **224** and internal to the memory card structure that houses the USB compliant connector **230**.

The USB connector **230** includes the electrical connector portion **220** and a conducting shield portion **222**. For example, the conducting shield portion **222** may be a metal shield that substantially surrounds the electrical connector portion **220** for electromagnetic shielding. Although one or more insertion guides **232-236** may protrude beyond the edge connector portion **224**, in a particular embodiment the entire electrical connector portion **220** is internal to the memory card **201** and does not extend outside of the edge connector portion **224**.

As illustrated, the edge connector portion **224** of the memory card **201** has a top-to-bottom thickness **226**. In a particular embodiment, the thickness **226** is less than or equal to approximately 3.3 millimeters. For example, the memory card **201** may have a shape and size form factor that complies with a CompactFlash Type 1 storage card specification that indicates that the thickness **222** is less than 3.4 millimeters, such as a nominal thickness of 3.3 millimeters and a tolerance of 0.05 millimeters.

Referring to FIG. 3, a third particular embodiment of a memory card **301** having a USB interface is depicted and generally designated **300**. The memory card **301** is illustrated in cross-section to reveal internal details of the memory card **301**. In a particular embodiment, the memory card **301** may have a shape and size form factor that substantially complies to a memory card specification such as the CompactFlash Type I specification.

The memory card **301** includes a USB receptacle **302** that has a shield portion **304**. The shield portion **304** has a metal thickness **306**. The USB receptacle **302** is coupled to a printed circuit board (PCB) **310**. Electrical traces (not shown) may electrically couple contacts of an electrical connector portion (not shown) of the USB receptacle **302** to a memory **314** via a controller **312**. The memory **314** and the controller **312** may be electrically and physically coupled to the PCB **310**. The electrical connector portion of the USB receptacle **302** is recessed within a region of an edge connector portion of the memory card **301**. The electrical connector portion of the USB receptacle **302** may be attached to the PCB **310** and may remain stationary with respect to the PCB **310** during normal operation.

A top and bottom surface of the memory card **301** are formed by a memory card structure that encloses the PCB **310** and the USB receptacle **302**, such as a shell top **316** and a shell bottom **318**. At least one of the shell top **316** or the shell bottom **318** has a shell wall thickness **320**. The shell wall thickness **320**, the metal thickness **306**, or both, may be modified so that an overall thickness **322** of the memory card structure, at least in the proximity to the USB receptacle **302**,

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complies with a shape and size form factor of a memory card specification. For example, in an embodiment where the USB receptacle **302** is a USB micro-B receptacle without top and bottom insertion guides, the USB micro-B receptacle having a specified metal thickness **306** of 0.15 millimeters (mm) could fit in a shape and size form factor of a CompactFlash Type I memory card specification if the overall thickness **322** is greater than a 2.1 mm height specified in the memory card specification, but still within an allowed variance at **2.15** mm. In an alternative embodiment, the metal thickness **306** of the receptacle could be reduced to 0.125 mm to meet the 2.1 mm specified card height.

In a particular embodiment, the USB receptacle **302** has a shape and size form factor that complies with a USB 2.0 or USB 3.0 micro-B specification. However, a top and bottom insertion guide of the USB receptacle **302** in compliance with a USB micro-B specification may extend above and below the USB receptacle **302** to a distance that causes the shell top **316** and shell bottom **318** to be undesirably thin when the overall thickness **322** complies with a memory card specification. Therefore, a top and bottom insertion guide of the USB receptacle **302** may not be formed by the metal shield **304** and may instead be formed by the memory card structure, such as by the shell top **316** and the shell bottom **318**. To illustrate, a top insertion guide **330** is formed from an elongated tapered portion **332** of the memory card structure. The elongated tapered portion **332** has a first thickness **334** at the edge of the memory card structure formed of the shell top **316**, and a second thickness **336** at the USB receptacle **302**. The first thickness **334** at the edge is less than the second thickness **336** at the USB receptacle **302**, providing an effective insertion guide that is substantially equivalent to the top insertion guide indicated by the USB micro-B receptacle physical specification. Similarly, the shell bottom **318** may have an elongated portion that may form a bottom insertion guide.

Referring to FIG. 4, a fourth particular embodiment of a memory card **401** having a USB interface is depicted and generally designated **400**. The memory card **401** is illustrated in a top view **402** and a cross sectional side view **404**. The memory card **401**, as illustrated in the cross sectional side view **404**, may be formed of a bottom substrate **408** onto which one or more components, such as a memory, a controller, or any combination thereof, may be mounted and electrically coupled to an electrical connector portion **420** of a USB receptacle. The electrical connector portion **420** may be substantially similar to the electrical connector portion **122** of FIG. 1 or the electrical connector portion **220** of FIG. 2. The substrate **408** may be covered with a top material **410** to form a memory card structure that does not have a substantially hollow interior, as opposed to the memory card **301** depicted in FIG. 3.

As illustrated, the memory card structure has a thickness **412** that may substantially comply with one or more memory card specifications. For example, the thickness **412** may be less than 1.5 millimeters, such as for example, 1.4 millimeters, to comply with a shape and size form factor of a miniSD flash memory card specification. As another example, the thickness **412** of the memory card structure may be less than approximately 1.1 millimeters, such as for example, 1.0 millimeters, to substantially comply with a shape and size form factor of a microSD flash memory card specification.

Because the thickness **412** of the memory card structure may be smaller than a thickness of a metal or conductive shield of a USB receptacle, such as the shield **304** depicted in FIG. 3, the memory card **401** may optionally include the electrical connector portion **420** of the USB receptacle but not include the metal shield portion of the USB receptacle. As

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illustrated, the electrical connector portion **420** may substantially correspond to the electrical connector portion of a USB 3.0 micro-B receptacle. For example, the electrical connector portion **420** has multiple electrical contacts, such as a representative contact **422**. When coupled to a mating USB plug, each contact **422** enables data transfer or signaling between the memory card **401** and a device coupled to the mating USB plug (not shown).

Referring to FIG. 5, a fifth embodiment of a memory card **501** having a USB interface is depicted and generally designated **500**. The memory card **501** is shown in a top view **502**, a side view **504**, and a front view **506**. As illustrated, the memory card **501** has a form factor that substantially conforms to a Personal Computer Memory Card International Association (PCMCIA) specification, such as a PC Card specification. However, as illustrated in the front view **506**, the memory card **501** does not have a PCMCIA electrical interface. Instead, the memory card **501** has a USB connector, such as the USB receptacle **508**. The USB receptacle **508** has an electrical connector portion **520** and a metal shield portion **522**. As illustrated, an edge connector portion of the memory card structure at the USB receptacle **508** may be dimensioned to have a size and shape form factor, including a thickness **510**, that complies with a PCMCIA specification.

Although the memory cards depicted in FIGS. 1-5 are illustrated as including USB connectors, in other embodiments one or more of the memory cards may instead, or additionally, include receptacles that substantially comply with an IEEE 1394 interface standard. For example, one or more of the memory cards depicted in FIGS. 1-5 may include a four-circuit Firewire-type connector in place of the USB connector. As another example, one or more of the memory cards depicted in FIGS. 1-5 may include an electrical connector portion of a six-circuit Firewire-type connector, such as depicted in FIGS. 6-9.

Referring to FIG. 6, a first embodiment of a memory card having an IEEE 1394 interface is depicted and generally designated **600**. The memory card **601** includes an IEEE 1394 receptacle or socket **602**, such as a six-circuit Firewire-type socket, that is attached to a memory card structure **604**.

The IEEE 1394 socket **602** includes an electrical connector portion **640** that includes an insertion wafer **612** and multiple signal contacts, such as a representative signal contact **610**. A metal shell **606** at least partially surrounds the electrical connector portion **640** to provide electromagnetic shielding and has an opening to enable access for connection with an IEEE 1394 plug (not shown). A detent **608** is positioned and spring-biased to assist in maintaining an attachment to an IEEE 1394 plug that may be connected to the IEEE 1394 socket **602**. An edge connector portion of the memory card **601** may have a thickness **614** of approximately 6.7 millimeters and may comply with a thickness or a shape and size form factor of a flash memory card specification or a PCMCIA specification.

The electrical connector portion **640** is attached to a printed circuit board (PCB) **616**. As illustrated, the electrical connector portion **640** may be formed to include at least a portion of an edge of the PCB **616** so that the insertion wafer **612** and the PCB **616** are integrated on a single piece of material. In other embodiments, the electrical connector portion **640** may be attached to the PCB **616** to remain stationary with respect to the PCB **616**. A controller **618** that is coupled to the electrical connector portion **640** is coupled to the PCB **616**. A memory **620** is coupled to the controller **618** and to the PCB **616**.

The memory card structure **604** is illustrated as a shell top and a shell bottom. The memory card structure **604** can be attached to the IEEE 1394 socket **602** via connection to the metal shell **606**, connection to a socket insulator **614**, or both.

The memory card structure **604** may also be attached to the PCB **616** via a mount **622**. For example, the mount **622** may be a structural element that supports and connects the PCB **616** to the memory card structure **604** to hold the PCB **616** stationary with respect to the memory card structure **604**. As a result of mechanical connections between the metal shell **606**, the insertion wafer **612**, the socket insulator **614**, the PCB **616**, the mount **622**, and the memory card structure **604**, the electrical connector portion **640** of the IEEE 1394 socket **602** may remain stationary and substantially or fully immobile with respect to the memory card structure **604**.

Referring to FIG. 7, a second embodiment of a memory card having an IEEE 1394 interface is depicted and generally designated **700**. The memory card **701** includes an IEEE 1394 socket **702**, such as a six-circuit socket that is substantially compliant with an IEEE 1394 interface standard, with a reduced height compared to the IEEE 1394 socket **602** of FIG. 6.

The IEEE 1394 socket **702** includes an electrical connector portion **740** that may be substantially similar to the electrical connector portion **640** of FIG. 6. The electrical connector portion **740** includes an insertion wafer **712** and multiple signal contacts, such as a representative signal contact **710**. The IEEE 1394 socket **702** has a detent **708** and a top portion of a metal shield **756**. The IEEE 1394 socket **702** does not include a bottom portion of the metal shield **756**, resulting in a reduced thickness compared to the IEEE 1394 socket **602** of FIG. 6. For example, an edge connector portion of the memory card **701** may have a thickness **714** of approximately 4.2 millimeters and may comply with a thickness or a shape and size form factor of a flash memory card specification or a PCMCIA specification.

The electrical connector portion **740** is attached to a memory card structure that includes a substrate **754** and a top material **756** to remain stationary with respect to the memory card structure. In a particular embodiment, the insertion wafer **712** may be formed as part of the substrate **754**. In another embodiment, the insertion wafer **712** may be attached to the substrate **754** to remain immobile with respect to the substrate **754**. A controller **718** and a memory **720** may be coupled to the substrate **754** and to the electrical connector portion **740**.

The memory card **701** is illustrated in a second embodiment **750** coupled to a plug **770**, such as an IEEE 1394 plug. As illustrated, the plug **770** is configured to surround the insertion wafer **712** beneath the metal shield **756** when connected. The plug **770** establishes an electrical connection with the memory card **701** via the signal contact **710**.

Referring to FIG. 8, a third embodiment of a memory card having an IEEE 1394 interface is depicted and generally designated **800**. The memory card **801** is illustrated in a front view **802** and a top view **804**. The memory card **801** includes an electrical connector portion **868** of an IEEE 1394 socket, such as an electrical connector portion of a six-circuit socket that is substantially compliant with an IEEE 1394 interface standard. In an illustrative embodiment, the electrical connector portion **868** may be substantially similar to the electrical connector portion **640** of FIG. 6 or the electrical connector portion **740** of FIG. 7.

The memory card **801** does not include a metal shell, such as the metal shell **606** of FIG. 6 or the metal shell **756** of FIG. 7. A phantom outline **870** illustrates a size and position of the metal shell **606** of FIG. 6 relative to the size and position of the electrical connector portion **868**. By not including a metal shell portion, an edge connector portion of the memory card **801** may have a smaller thickness than an edge connector portion of the memory card **601** of FIG. 6 and the memory

card **701** of FIG. 7. For example, an edge connector portion of the memory card **801** may have a thickness **814** of approximately 1.6 millimeters and may comply with a thickness or a shape and size form factor of a flash memory card specification, such as a CompactFlash Type I specification, or a PCMCIA specification.

Referring to FIG. 9, a particular embodiment of a system including a card holder to receive a memory card having a USB interface is depicted and generally designated **900**. The system **900** includes a device **902** coupled to a memory card **914** having a USB connector **912**. The device **902** is also coupled to an external host device **922**. In a particular embodiment, the memory card **914** is the card **101** of FIG. 1, the memory card **201** of FIG. 2, the memory card **301** of FIG. 3, the memory card **401** of FIG. 4, or the memory card **501** of FIG. 5.

In a particular embodiment, the device **902** includes a housing **903** that encloses a device controller **904**. The device controller **904** is coupled to a device memory **906** and is also coupled to access one or more device functions **908**. The device controller **904** is also coupled to a first USB connector **910** that may be secured within the housing **903**, such as a USB plug or a USB receptacle. In a particular embodiment, the first USB connector **910** is compliant with a USB micro-B physical specification, such as a USB 3.0 or USB 2.0 micro-B plug.

The housing **903** at least partially encloses a card holder **916**. The housing **903** has an opening **950** that is dimensioned to enable insertion of the memory card **914** into the card holder **916**. The card holder **916** may be dimensioned to receive and to hold a card having a shape and size form factor complying with a memory card specification, such as the memory card **914** having the USB connector **912**. In addition, the first USB connector **910** may be configured to electrically connect or couple to the USB connector **912** of the memory card **914** when the memory card **914** is inserted within the card holder **916**. The device **902** also includes a third USB connector **918** that is electrically coupled to the device controller **904** and further electrically coupled to the first USB connector **910**. In a particular embodiment, the third USB connector **918** is configured to couple to a USB connector **920** coupled to the external host device **922** to enable communication with the external host device **922**. For example, the device **902** may include a digital camera and the external host device **922** may be a personal computer or laptop computer that can download image files from the device **902**. As other examples, the device **902** may be a cellular phone or mobile phone, a game console, a media recorder or player, a personal digital assistant (PDA), a printer, or any other device that may receive and interact with a memory card and that may be coupled to an external host device.

In a particular embodiment, the device controller **904** includes a host enable/disable module **930** and the device controller **904** also includes a USB host interface **932**. When the device controller **904** detects that the third USB connector **918** is not coupled to the external host device **922** (e.g. the USB connector **920** is not coupled to the third USB connector **918**), the device controller **904** may enable operation of the USB host interface **932**. The USB host interface **932** may be configured to act as a host to the memory card **914** via the first USB connector **910** coupled to the USB connector **912** of the memory card **914**.

The host enable/disable module **930** is configured to detect when power is received on a power line **952**. Detecting power on the power line **952** indicates that a host device, such as the external host device **922**, is coupled to the third USB connector **918**. When the device controller **904** recognizes that

power is being supplied on the power line **952**, the host enable/disable module **930** may disable operation of the USB host interface **932** from operating as a USB host to the memory card **914**, and the first USB connector **910** may receive signaling from the third USB connector **918** that is coupled to the external host **922** via the USB connector **920**.

Thus, data and other functions that may be associated with the memory card **914** may be accessible to the external host device **922** by coupling the first USB connector **910** to the third USB connector **918** and disabling the USB host interface **932**. When the external host device **922** is determined to be uncoupled to the third USB connector **918**, the device controller **904** may be configured to enable the USB host interface **932** so that the device controller **904** may communicate with the memory card **914** via a USB command and data transfer protocol.

Referring to FIG. 10, a second particular embodiment of a system to receive and interact with a memory card having a USB interface is depicted and generally designated **1000**. The system **1000** includes a device **1002** that is coupled to an external host device **1022** and the device **1002** is configured to receive a memory card **1014** having a USB connector **1012**. In a particular embodiment, the memory card **1014** is the card **101** of FIG. 1, the memory card **201** of FIG. 2, the memory card **301** of FIG. 3, the memory card **401** of FIG. 4, or the memory card **501** of FIG. 5.

In a particular embodiment, the device **1002** includes a housing **1003** that encloses a device controller **1004**. A device memory **1006** and device functions **1008** are accessible to the device controller **1004**. The device **1002** also includes a first USB connector **1010** that may be secured within the housing **903**, such as a USB plug or a USB receptacle that is coupled to the device controller **1004**. In a particular embodiment, the first USB connector **1010** may be compliant with a USB micro-B physical specification, such as a USB 2.0 micro-B plug or a USB 3.0 micro-B plug. The first USB connector **1010** and the device controller **1004** are also coupled to a USB hub **1024**.

The housing **1003** at least partially encloses a card holder **1016**. The housing **1003** has an opening **1050** that is dimensioned to enable insertion of the memory card **1014** into the card holder **1016**. The card holder **1016** may be dimensioned to receive and to hold a card having a shape and size form factor complying with a memory card specification, such as the memory card **1014** with the USB connector **1012**. The first USB connector **1010** may be configured to electrically connect or couple to the USB connector **1012** of the memory card **1014** when the memory card **1014** is inserted within the card holder **1016**.

In a particular embodiment, the device controller **1004** includes a USB interface **1034** that is capable of functioning as a USB device interface in response to determining that the external host device **1022** is coupled to the USB hub **1024**. The USB interface **1034** is also capable of functioning as a host interface to the memory card **1012** via the first USB connector **1010** in response to determining that the external host device **1022** is not coupled to the USB hub **1024**. In a particular embodiment, the USB interface **1034** is a USB On-The-Go (OTG) interface.

As a result, when the external host device **1022** is not coupled to the USB hub **1024**, the USB interface **1034** functions as a host to the memory card **1014** that is held at the card holder **1016**. However, when the external host device **1022** is coupled to the USB hub **1024** via a USB connector **1020**, the USB interface **1034** is reconfigured to act as a USB device interface, such that the external host device **1022** may interact with the device controller **1004** as a USB device and may

further interact with the memory card **1014** as a second USB device via the first and second USB connectors **1010** and **1012**, respectively.

Referring to FIG. 11, a third particular embodiment of a system to receive and interact with a memory card with a USB interface is depicted and generally designated **1100**. The system **1100** includes a device **1102** coupled to an external host device **1122**. The device **1102** includes a card holder **1116** that is configured and dimensioned to receive a memory card **1114** having a USB connector **1112**. In a particular embodiment, the memory card **1114** is the card **101** of FIG. 1, the memory card **201** of FIG. 2, the memory card **301** of FIG. 3, the memory card **401** of FIG. 4, or the memory card **501** of FIG. 5.

The device **1102** includes a housing **1103** that encloses a device controller **1104**. A device memory **1106** and one or more device functions **1108** are accessible to the device controller **1104**. The device controller **1104** is also coupled to a first USB connector **1110**. For example, the first USB connector **1110** may be a USB 3.0 micro-B plug.

The housing **1103** also at least partially encloses the card holder **1116**. The housing **1103** has an opening **1150** that is dimensioned to enable insertion of the memory card **1114** into the card holder **1116**. The card holder **1116** may be dimensioned to receive and to hold a card having a shape and size form factor complying with a memory card specification, such as the memory card **1114** having the USB connector **1112**.

The first USB connector **1110** may be configured to couple to a second USB connector, such as the USB connector **1112** of the memory card **1114** when the memory card **1114** is inserted within the card holder **1116**. The device **1102** also includes a third USB connector **1118** that is coupled to the device controller **1104** and that is configured to be connected to the external host device **1122** via a USB connector **1120**.

In a particular embodiment, the device controller **1104** includes a USB device interface **1136** that is coupled to the third USB connector **1118**. The USB device interface **1136** enables the external host device **1122** to interact with the device **1102**, and in particular, to access the device memory **1106** and the device functions **1108**. The device controller **1104** also includes a USB host interface **1132** that is coupled to function as a host to the memory card **1114** when the memory card **1114** is inserted into the card holder **1116** such that the first USB connector **1110** is coupled to the USB connector **1112** of the memory card **1114**.

The device controller **1104** is configured to mediate access of the external host device **1122** to the memory card **1114** via the USB host interface **1132**. In a particular embodiment, the device controller **1104** is configured to receive USB instructions and formatted data provided by the external host device **1122** and received via the USB device interface **1136**. The USB instructions may include instructions to access memory or other functions at the memory card **1114**. The USB instructions may be routed to the first USB connector **1110** via the USB host interface **1132**. For example, the device controller **1104** may be configured to pass USB signaling **1138** from the device interface **1136** to the USB host interface **1132**, from which the USB host interface **1132** may provide the USB signaling **1138** to the memory card **1114**. Thus, the device controller **1104** may act as a pass-through mechanism to enable the external host device **1122** to access a memory within the memory card **1114**, without translation of USB protocol instructions from the external host device **1122** to another protocol format.

In a particular embodiment, the device controller **1104** presents the memory card **1114** to the external host device

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1122 by implementing a device interface for the memory card 1114. In another embodiment, the device controller 1104 may be configured to enable communication of the external host device 1122 to the memory card 1114 without implementing a separate device interface for the memory card 1114. Instead, the device controller 1104 may perform a memory mapping operation to map instructions from the external host device 1122 to the USB host interface 1132 to be directed to the memory card 1114.

Referring to FIG. 12, a fourth illustrative embodiment of a system to receive and to interact with a memory card having a USB connector is depicted and generally designated 1200. The system 1200 includes a device 1202 coupled to an external host device 1222 and configured to be connected to a memory card 1214 having a USB connector 1212. In a particular embodiment, the memory card 1214 is the card 101 of FIG. 1, the memory card 201 of FIG. 2, the memory card 301 of FIG. 3, the memory card 401 of FIG. 4, or the memory card 501 of FIG. 5.

The device 1202 includes a housing 1203 enclosing a device controller 1204 having one or more USB interfaces. The device 1202 also includes a card holder 1216 that is dimensioned to receive the memory card 1214. A USB connector, such as a USB plug 1210, is coupled to the device controller 1204 via a flexible cable 1240. The cable 1240 has sufficient length to enable the USB plug 1210 to exit through an opening 1250 in the housing 1203. The USB plug 1210 may be extended outside the card holder 1216 via the opening 1250 for a user to manually attach the USB plug 1210 to the USB connector 1212 of the memory card 1214. After attaching the USB plug 1210 to the memory card 1214, the memory card 1214 may be inserted into the card holder 1216 for operation with the device 1202.

The device 1202 also includes a USB connector 1218 that is configured to couple to the external host device 1222 via a USB connector 1220. In a particular embodiment, the device controller 1204 enables the external host device 1222 to interact with the memory card 1214, and when the external host device 1222 is not coupled to the USB connector 1218, the device controller 1204 can access the card 1214 via a USB host interface. To illustrate, the device controller 1204 may be the device controller 904 of FIG. 9, the device controller 1004 of FIG. 10, or the device controller 1104 of FIG. 11, as illustrative, non-limiting examples.

Although the devices of FIGS. 9-12 are illustrated and described as having USB connectors, in other embodiments one or more of the devices of FIGS. 9-12 may instead use connectors compatible with the IEEE 1394 interface protocol. For example, in a particular embodiment, a device, such as the device 902 of FIG. 9, may include a first connector, such as the first connector 910, that is compatible with an IEEE 1394 interface standard and a card holder, such as the card holder 916 associated with the first connector. The controller 904 is coupled to the first connector, and the housing 903 encloses the controller and at least partially encloses the card holder. The housing 903 has an opening 950 that is dimensioned to enable insertion of a memory card into the card holder 916. The first connector may be configured to connect to a second connector of the memory card when the memory card is inserted into the card holder, where the second connector is compatible with the IEEE 1394 interface standard. As illustrative, non-limiting examples, the memory card may be the memory card 601 of FIG. 6, the memory card 701 of FIG. 7, or the memory card 801 of FIG. 8. For example, the card holder may include hardware adapted to receive and hold a card having a form factor that is compliant with a flash memory card specification, the card further having an elec-

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trical connector portion of a receptacle that is compatible with the IEEE 1394 interface standard within an edge connector portion of the card. As another example, the card holder may include hardware adapted to receive and hold a card having a form factor that is compliant with a Personal Computer Memory Card International Association (PCMCIA) specification, where the card includes an electrical connector portion of a receptacle that is compatible with the IEEE 1394 interface standard within an edge connector portion of the card.

Referring to FIG. 13, an illustration 1300 including an embodiment of a memory card holder that is dimensioned to receive and hold a memory card having a USB or IEEE 1394 interface is depicted. A memory card hardware apparatus 1302 is illustrated in a top view 1304, a side view 1306, and a front view 1308. The memory card hardware apparatus 1302 includes a memory card holder formed of a right card edge guide 1312 and a left card edge guide 1314. The card edge guides 1312 and 1314 are positioned and dimensioned to receive an inserted memory card to connect to a PCMCIA connector 1316.

A USB or IEEE 1394 memory card hardware apparatus 1352 in accordance with an embodiment of the present disclosure is illustrated in a top view 1354, a side view 1356, and a front view 1358. The USB or IEEE 1394 memory card apparatus 1352 includes the memory card holder formed of the right card edge guide 1312 and the left card edge guide 1314 of the memory card apparatus 1302. The card edge guides 1312 and 1314 are positioned and dimensioned to receive an inserted memory card to connect to a connector 1366. The connector 1366 is positioned relative to the card holder to be coupled to a memory card when the memory card is within the memory card holder. In a particular embodiment, the connector 1366 may be a USB connector, such as a USB 2.0 micro-B plug or a USB 3.0 micro-B plug. In another embodiment, the connector 1366 may be an IEEE 1394 connector (not shown).

In a particular embodiment, the memory card holder includes hardware such as the card edge guides 1312 and 1314 adapted to hold a card having a form factor that is compliant with a flash memory card specification, in one embodiment, or a PCMCIA specification, in another embodiment, and also having an electrical connector portion of a USB compatible receptacle within an edge of the card. For example, the memory card hardware apparatus 1352 including the memory card holder formed of the right card edge guide 1312 and the left card edge guide 1314 may be adapted to hold any of the memory cards depicted in FIGS. 1-5. In a particular embodiment, the memory card holder of the memory card hardware apparatus 1352 may be the card holder 916 of FIG. 9, the card holder 1016 of FIG. 10, the card holder 1116 of FIG. 11, or the card holder 1216 of FIG. 12.

Referring to FIG. 14, an illustration 1400 including an embodiment of a memory card holder dimensioned to receive and hold a memory card having a USB or IEEE 1394 interface is depicted. A memory card hardware apparatus 1402 is illustrated in a top view 1404, a side view 1406, and a front view 1408. The memory card hardware apparatus 1402 includes a memory card holder 1412 that is positioned and dimensioned to receive an inserted memory card to connect to a PCMCIA connector 1416 that is integrated within the memory card holder 1412.

A USB or IEEE 1394 memory card hardware apparatus 1452 in accordance with an embodiment of the present disclosure is illustrated in a top view 1454, a side view 1456, and a front view 1458. The USB or IEEE 1394 memory card hardware apparatus 1452 includes the memory card holder

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1412 of the memory card hardware apparatus 1402; however, rather than having the integrated PCMCIA connector 1416, the memory card holder 1412 has an integrated connector 1466. The connector 1466 is positioned relative to the card holder 1412 to be coupled to a memory card when the memory card is within the memory card holder. In a particular embodiment, the integrated connector 1466 is a USB connector, such as a USB 2.0 micro-B plug or a USB 3.0 micro-B plug. In another embodiment, the integrated connector 1466 is an IEEE 1394 connector (not shown).

In a particular embodiment, the memory card holder 1412 includes hardware such as card edge guides adapted to hold a card having a form factor that is compliant with a flash memory card specification, in one embodiment, or a PCMCIA specification, in another embodiment, and also having an electrical connector portion of a USB compatible receptacle recessed within an edge portion of the card. For example, the memory card hardware apparatus 1452 including the memory card holder 1412 with the integrated connector 1466 may be adapted to hold any of the memory cards depicted in FIGS. 1-5. In a particular embodiment, the memory card holder 1412 may be the card holder 916 of FIG. 9, the card holder 1016 of FIG. 10, the card holder 1116 of FIG. 11, or the card holder 1216 of FIG. 12.

Referring to FIG. 15, a flow diagram of a particular embodiment of a method of making a memory card having a USB interface is depicted and generally designated 1500. The method 1500 may include attaching a memory to a substrate, at 1502. For example, the substrate may include a printed circuit board (PCB), such as the PCB 310 of FIG. 3. In another embodiment, the substrate may be the substrate 408 of FIG. 4.

A controller may be attached to the substrate, at 1504. The controller may be configured to control a memory. For example, the controller may be the controller circuitry 106 of FIG. 1. As another example, the controller may be the controller 312 of FIG. 3.

A Universal Serial Bus (USB) receptacle may be attached to the substrate to be coupled to the controller, at 1506. For example, the USB receptacle may comply with a USB micro-B specification, such as a USB 2.0 micro-B specification or a USB 3.0 micro-B specification. As another example, the USB receptacle may substantially comply with a USB micro-B specification other than at least one insertion guide. As another example, the USB receptacle may have an electrical connector portion that complies with a USB Micro-B specification but may not include a conductive shield portion. As illustrative, non-limiting examples, the USB receptacle may be the receptacle 132 of FIG. 1, the receptacle 230 of FIG. 2, the receptacle 302 of FIG. 3, the receptacle 508 of FIG. 5, or another receptacle. The USB receptacle is attached to the substrate to remain stationary with respect to the memory and the controller.

A memory card structure may be formed around the memory, the controller, and the USB receptacle, at 1508. The memory card structure may have an edge connector portion having a shape and size form factor that is compliant with a memory card specification. The edge connector portion may enable access to a USB plug to form a connection to the USB receptacle. In a particular embodiment, forming the memory card structure may include assembling a shell that encloses the memory and the controller and that forms an opening to enable access to the USB receptacle. For example, assembling the shell may include joining the shell top 316 and the shell bottom 318 of FIG. 3. In another embodiment, forming the memory card structure may include forming a top layer on the substrate, such as the top layer 410 on the substrate 408 of FIG. 4.

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Referring to FIG. 16, a flow diagram of a particular embodiment of a method of selecting a host to communicate with a memory card having a USB interface is depicted and generally designated 1600. In an illustrative embodiment, the method 1600 may be performed by a device that is configured to couple to an external host via a USB interface and that is configured to couple to a memory card via a USB interface. In a particular embodiment, the method 1600 may be performed by the device 902 of FIG. 9, the device 1002 of FIG. 10, the device 1102 of FIG. 11, or the device 1202 of FIG. 12.

A memory card may be received at a memory card holder that is dimensioned to receive and hold a memory card having a shape and size form factor complying with a memory card specification, at 1602. As illustrative, non-limiting examples, the memory card holder may be the card holder 916 of FIG. 9, the card holder 1016 of FIG. 10, the card holder 1116 of FIG. 11, the card holder 1216 of FIG. 12, a card holder including the card edge guides 1312 and 1314 of FIG. 13, the card holder 1412 of FIG. 14, or another card holder.

A connection of a first Universal Serial Bus (USB) connector to a second USB connector may be detected, at 1604. The first USB connector may be coupled to a device controller and the second USB connector may be coupled to a memory card within a memory card holder.

A determination may be made whether an external host is coupled to the device controller, at 1606. In response to detecting the external host, at 1608, the device controller may be configured to enable the external host to access data stored at the memory card via USB commands, at 1610. In a particular embodiment, the external host is coupled to the device controller via a third USB connector.

In response to not detecting the external host, the device controller may be configured to function as a host to the memory card, at 1612. In a particular embodiment, configuring the device controller to function as the host enables the device controller to access data stored at the memory card via USB commands.

Communication between the external host and the device controller and communications between the device controller and the memory card may comply with a USB communication protocol. The device controller may use pass-through USB signaling, as described with respect to FIG. 11, or may implement a USB On-The-Go (OTG) interface, as described with respect to FIG. 10, as illustrative, non-limiting examples. As a result, the device controller may enable communications between the external host and the memory card without devoting processing resources for translation of commands and data between different protocols.

Referring to FIG. 17, an illustrative embodiment of a system that can be used to enable access to a memory via a USB interface is depicted and generally designated 1700. The system 1700 includes a device 1702 that includes a device controller 1704 coupled to one or more memory cards having USB connectors, such as a representative memory card 1708 having a USB connector, via a universal serial bus 1706. The representative memory card 1708 having the USB connector includes USB interface circuitry 1790 to communicate via the universal serial bus 1706. The memory card 1708 having the USB connector also includes a controller 1792 that is coupled to the USB interface circuitry 1790 and that is also coupled to a memory, such as a memory array 1794. The memory array 1794 may include one or more types of storage media such as a flash memory, a one-time programmable memory, other memory, or any combination thereof. In a particular embodiment, the device 1702 may be the device 902 of FIG. 9, the device 1002 of FIG. 10, the device 1102 of FIG. 11, or the device 1202 of FIG. 12. In an illustrative embodiment, the

memory card 1708 having the USB connector may be any of the memory cards depicted in FIGS. 1-5. In addition, the memory card 1708 having the USB device is held at a memory card holder, such as any of the card holders of FIGS. 9-14.

In a particular embodiment, the device controller 1704 includes USB interface circuitry 1710 coupled to a direct memory access (DMA)/bus controller 1720. The device controller 1704 also includes USB memory card interface circuitry 1740 that is coupled to the DMA/bus controller 1720. A processor core 1730, a random access memory (RAM) 1722 and a read-only memory (ROM) 1724 are coupled to the DMA/bus controller 1720 via an internal bus.

In a particular embodiment, the USB interface circuitry 1710 includes USB electrical connectors 1712 coupled to input/output (I/O) buffers and latches 1714. The bus connectors 1712 are further coupled to output driver circuitry 1716. The USB interface circuitry 1710 also includes a controller 1718. In a particular embodiment, the USB interface circuitry 1710 operates in accordance with a universal serial bus (USB) protocol. For example, the controller 1718 may be programmed to receive USB protocol instructions and data from an external host device, such as the external host device 922 of FIG. 9, the external host device 1022 of FIG. 10, the external host device 1122 of FIG. 11, or the external host device 1222 of FIG. 12, via the USB electrical connectors 1712 that are coupled to a universal serial bus. The controller 1718 may include a hardware processor that executes instructions stored at an internal memory, such as a read-only memory (not shown) to enable receipt and acknowledgment of USB instructions and data.

In a particular embodiment, the processor core 1730 includes an instruction cache 1732, a load/store unit 1734, an arithmetic logic unit (ALU) unit 1736, and a register file 1738. The processor core 1730 may include, or may function substantially similarly to, an ARM core, as an illustrative, non-limiting example. For example, the processor core 1730 may support a reduced instruction set computer (RISC) micro-architecture. The processor core 1730 may be configured to retrieve data and executable instructions 1726 via the load/store unit 1734 from the read only memory 1724. The executable instructions 1726 may include instructions that are executable to run at least a portion of the host enable/disable module 930 of FIG. 9, the USB host interface 932 of FIG. 9, the USB On-The-Go interface 1034 of FIG. 10, the USB signaling 1138 between the USB device interface 1136 and the USB host interface 1132 of FIG. 11, or any combination thereof.

Alternatively, or in addition, at least some of the executable instructions 1726 may not be stored at the ROM 1724 and may instead be stored at the memory array 1794. The executable instructions 1728 may be retrieved from the memory array 1794 and stored at the RAM 1722. The processor core 1730 may be configured to retrieve the executable instructions 1728 from the RAM 1722 for execution.

One or more executable instructions 1726 may be retrieved by the load/store unit 1734 and stored to the instruction cache 1732. The instructions at the instruction cache 1732 may be scheduled and provided to one or more execution pipelines, such as an execution pipeline including the ALU unit 1736. The ALU unit 1736 may include dedicated circuitry to perform arithmetic and logic operations, such as addition and subtraction, AND, NOT, OR, exclusive-OR (XOR), other arithmetic or logic operations, or any combination thereof. The ALU unit 1736 may receive data from, and write data to, the register file 1738. The register file 1738 may include

multiple memory cells that may provide high speed access to the processor core 1730 of data to be used for execution of instructions.

In a particular embodiment, the processor core 1730 may be programmed to perform at least a portion of the method 1600 of FIG. 16. For example, the processor core 1730 may be programmed to detect a connection of the memory card 1708 having the USB connector to the USB memory interface circuitry 1740 and to determine whether an external host device is coupled to a USB connector that includes the USB electrical connectors 1412 of the USB interface circuitry 1710. When the external host is detected, the processor core 1730 may configure the device controller 1704 to enable the external host to access data stored at the memory card 1708 having the USB connector via USB commands. When the external host is not detected, the processor core 1730 may configure the device controller 1704 to function as a host to the memory card 1708 having the USB connector via the USB memory card interface circuitry 1740.

The USB memory card interface circuitry 1740 may include USB electrical connectors 1742, an output driver 1744, and input/output buffers and latches 1746. The data bus connectors 1742 may include electrical connectors to enable electrical signal propagation via the universal serial bus 1706. The I/O buffers and latches 1746 may be configured to store data that is received via the DMA/bus controller 1720 to be transmitted via the universal serial bus 1706 using electrical signals at the USB electrical connectors 1742 that are generated by the output driver 1744. In addition, or alternatively, the I/O buffers and latches 1746 may store data values represented by electrical signals received at the USB electrical connectors 1742 via the data universal serial bus 1706, such as signals generated by the USB interface circuitry 1790 of the memory card 1708 having the USB connector. Alternatively, the device controller 1704 may provide an electrical connection between the USB electrical connectors 1712 and the USB electrical connections 1742 to provide a connection between the USB connectors allowing command and data transfer without processing by the device controller 1704.

Although various components depicted herein are illustrated as block components and described in general terms, such components may include one or more microprocessors, state machines, or other circuits configured to enable the disclosed data storage devices, such as the memory card 101 of FIG. 1, to perform the particular functions attributed to such components. For example, the USB interface 104, the controller circuitry 106, or both, of FIG. 1, may represent physical components, such as controllers, state machines, logic circuits, or other structures to enable the memory card 101 to receive and respond to requests from a host device or from other external devices to access the memory 108.

For example, the controller circuitry 106 of FIG. 1 may be implemented using a microprocessor or microcontroller programmed to respond to data access commands received via the USB interface 104. In a particular embodiment, the controller circuitry 106 of FIG. 1 includes executable instructions that are executed by a processor and the instructions may be stored at the memory 108. Alternatively, or in addition, executable instructions that are executed by the processor may be stored at a separate memory location that is not part of the memory 108, such as at a read-only memory (ROM) (not shown) at the controller circuitry 106.

In a particular embodiment, the memory card 101 having the USB interface may be a portable device configured to be selectively coupled to one or more external devices. However, in other embodiments, the memory card 101 having the USB interface may be attached or embedded within one or more

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host devices, such as within a housing of a portable communication device. For example, the data memory card **101** having the USB interface may be within a packaged apparatus such as a wireless telephone, personal digital assistant (PDA), gaming device or console, portable navigation device, or other device that uses internal non-volatile memory. In a particular embodiment, the memory card **101** having the USB interface includes a non-volatile memory, such as a flash memory (e.g., NAND, NOR, Multi-Level Cell (MLC), Divided bit-line NOR (DINOR), AND, high capacitive coupling ratio (HiCR), asymmetrical contactless transistor (ACT), or other flash memories), an erasable programmable read-only memory (EPROM), an electrically-erasable programmable read-only memory (EEPROM), a read-only memory (ROM), a one-time programmable memory (OTP), or any other type of memory.

The illustrations of the embodiments described herein are intended to provide a general understanding of the structure of the various embodiments. The illustrations are not intended to serve as a complete description of all of the elements and features of apparatus and systems that utilize the structures or methods described herein. Many other embodiments may be apparent to those of skill in the art upon reviewing the disclosure. Other embodiments may be utilized and derived from the disclosure, such that structural and logical substitutions and changes may be made without departing from the scope of the disclosure. Although specific embodiments have been illustrated and described herein, it should be appreciated that any subsequent arrangement designed to achieve the same or similar purpose may be substituted for the specific embodiments shown. This disclosure is intended to cover any and all subsequent adaptations or variations of various embodiments. Combinations of the above embodiments, and other embodiments not specifically described herein, will be apparent to those of skill in the art upon reviewing the description. Accordingly, the disclosure and the figures are to be regarded as illustrative rather than restrictive.

The Abstract of the Disclosure is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims. In addition, in the foregoing Detailed Description, various features may be grouped together or described in a single embodiment for the purpose of streamlining the disclosure. This disclosure is not to be interpreted as reflecting an intention that the claimed embodiments require more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive subject matter may be directed to less than all of the features of any of the disclosed embodiments.

The above-disclosed subject matter is to be considered illustrative, and not restrictive, and the appended claims are intended to cover all such modifications, enhancements, and other embodiments, which fall within the scope of the present disclosure. Thus, to the maximum extent allowed by law, the scope of the present invention is to be determined by the broadest permissible interpretation of the following claims and their equivalents, and shall not be restricted or limited by the foregoing detailed description.

What is claimed is:

1. A data storage device comprising:
a memory card body dimensioned to house a memory and a controller, wherein the memory card body includes an edge connector portion having a thickness that complies with a memory card specification, and wherein the edge connector portion includes a recessed portion, the recessed portion dimensioned to receive an external plug;

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an electrical connector that is coupleable to a Universal Serial Bus (USB) plug and that is electrically coupled to at least one of the memory and the controller, wherein the electrical connector extends from the recessed portion of the edge connector portion of the memory card body; and

a shell comprising a first shell surface having a first elongated tapered portion that partially encloses the electrical connector and a second shell surface having a second elongated tapered portion, wherein at least one of the first shell surface and the second shell surface forms an insertion guide.

2. The data storage device of claim **1**, wherein the electrical connector does not extend beyond the recessed portion of the edge connector portion of the memory card body.

3. The data storage device of claim **1**, further comprising a shield that at least partially surrounds the electrical connector.

4. The data storage device of claim **3**, wherein the shield is metallic.

5. The data storage device of claim **3**, wherein the shield has a shield length and a shield width, and wherein the shield length is larger than an electrical connector length of the electrical connector.

6. The data storage device of claim **1**, wherein the thickness complies with a miniSD flash memory card specification.

7. The data storage device of claim **1**, wherein the thickness complies with a microSD flash memory card specification.

8. The data storage device of claim **1**, wherein the electrical connector corresponds to an electrical connector of a USB 3.0 micro-B receptacle.

9. The data storage device of claim **1**, wherein the memory card body has a form factor that substantially conforms to a Personal Computer Memory Card International Association (PCMCIA) specification.

10. The data storage device of claim **1**, wherein the electrical connector corresponds to an International Society of Electrical and Electronic Engineers (IEEE) 1394 interface standard.

11. The data storage device of claim **1**, wherein the electrical connector includes a six-circuit Firewire-type connector.

12. The data storage device of claim **1**, wherein the memory card body includes a detent, the detent positioned to reversibly contact an external plug upon insertion of the external plug into the recessed portion.

13. The data storage device of claim **12**, wherein the detent is spring-loaded.

14. The data storage device of claim **1**, wherein the thickness substantially complies with a Personal Computer Memory Card International Association (PCMCIA) specification.

15. The data storage device of claim **1**, wherein the thickness substantially complies with a CompactFlash Type I specification.

16. The data storage device of claim **1**, wherein the memory card body has a form factor that substantially conforms to a CompactFlash Type I specification.

17. A data storage device comprising:

a memory card structure including:
an edge connector portion, wherein the edge connector portion has a thickness that complies with a memory card specification; and

a shell comprising a first shell surface having a first elongated tapered portion that partially encloses the edge connector portion and a second shell surface having a second elongated tapered portion, wherein at

least one of the first shell surface and the second shell surface forms an insertion guide, wherein the memory card structure includes a recessed portion, the recessed portion dimensioned to receive an Institute of Electrical and Electronic Engineers (IEEE) 1394 plug; and

an electrical connector compatible with the IEEE 1394 standard, wherein the electrical connector extends from the recessed portion of the memory card structure.

18. The data storage device of claim **17**, wherein the electrical connector includes a signal contact that is affixed to the memory card structure at a first signal contact end of the signal contact, the signal contact being electrically conducting and configured to electrically couple to the IEEE 1394 plug by reversibly deforming in response to a transverse force applied to a second signal contact end of the signal contact.

19. The data storage device of claim **17**, wherein the memory card structure includes a detent, the detent positioned to reversibly contact the IEEE 1394 plug upon insertion of the IEEE 1394 plug into the recessed portion.

20. The data storage device of claim **17**, wherein the edge connector portion has a size form factor that complies with a Personal Computer Memory Card International Association (PCMCIA) specification.

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